AUTOMOTIVE INDUSTRIES

AUTOMOTIVE and AVIATION MANUFACTURING
ENGINEERING • PRODUCTION • MANAGEMENT

MARCH 1, 1957

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A CHILTON PUBLICATION

They cut out three oils by changing to one...

STANICUT Oil 166 BC

Screw machine plant saves on oil inventory and handling, receives other benefits by converting to dual-purpose cutting oil.

Standard Oil lubrication specialist Bob Cleland and plant manager I. G. Smallegan inspect machined piece. Giving technical help to customers like this is something for which Bob Cleland is well fitted. Bob has a mechanical engineering degree from Michigan State University and has completed the Standard Oil Company Sales Engineering School.

Grand Rapids Metal Products Company's problem was the mixing of cutting and lubricating oils in their National Acme and Gridley screw machines. In all, four oils were used. In some machines a cutting oil, two lubricating oils and a base oil were employed to improve machining characteristics. Lubricating oil leaking past seals mixed with the cutting oil, reducing cutting oil qualities. Oil mixtures were constantly varying, and troubles in tapping resulted.

Standard Oil's Bob Cleland, working with plant management, suggested STANICUT Oil 166 BC. This oil, he explained, is a dual-purpose oil. It can be used for lubrication as well as for cutting. In such applications, no dilution of the cutting oil can occur.

After a week's trial in one machine, the entire plant was converted to STANICUT Oil 166 BC. Tap troubles were reduced, resulting in much less down time. Spindle speeds have been increased, yet the spindles run cool. Four oils were formerly kept in stock. Now only one is needed.

STANICUT Oil 166 BC does not corrode bearings, gears, bushings, spindles or other machine parts. While the oil contains E.P. additives, it does not stain copper or brass.

Get the facts on how STANICUT Oil 166 BC can help you. Call the Standard Oil office nearest you anywhere in 15 Midwest and Rocky Mountain states. Or write Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Quick facts about
STANICUT OIL 166 BC

1	A dual-purpose oil — suitable for both cutting and lubrication.
2	Non-corrosive to work or machines.
3	Formulated with E.P. additives.
4	Stable under all normal conditions.
5	Non-irritating.
6	A cutting oil that permits high operating speeds.
7	Non-staining to either copper or brass.

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STANDARD OIL COMPANY
(Indiana)

Vibration won't loosen FLEXLOC self-locking nuts

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Standard FLEXLOC self-locking locknuts are available in a wide range of standard sizes, types and materials to meet the most critical locknut requirements. Your local industrial distributor stocks them. Write us for complete catalog and technical data. Flexloc Locknut Division, STANDARD PRESSED STEEL CO., Jenkintown 53, Pa.

FLEXLOC® LOCKNUT DIVISION

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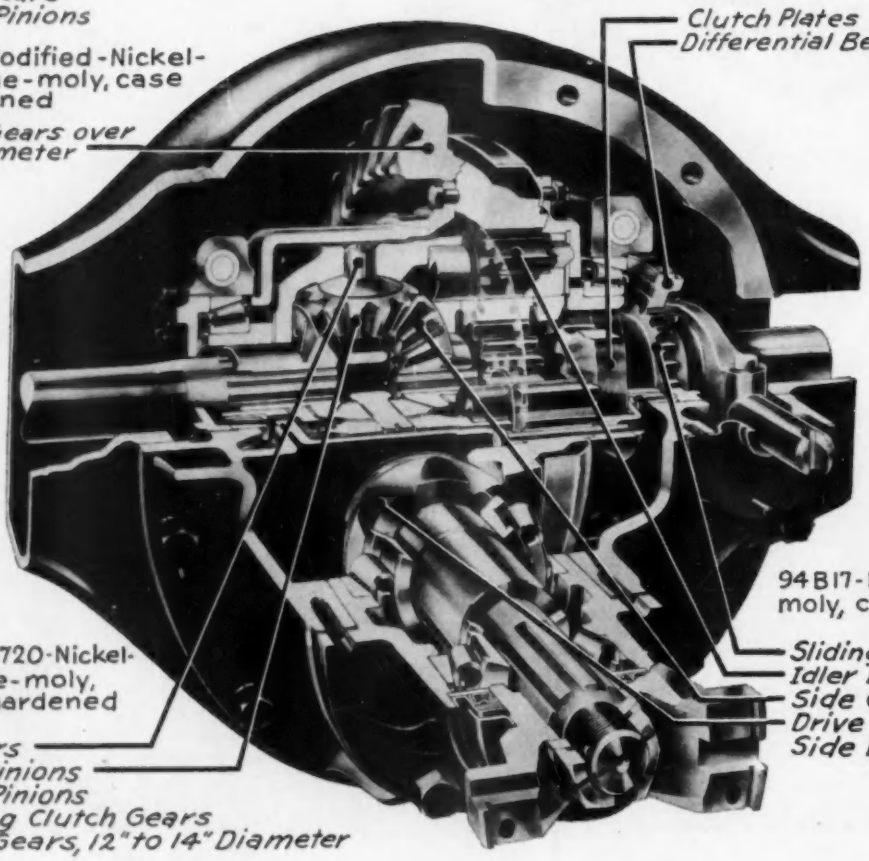
SPS

JENKINTOWN PENNSYLVANIA

These are the nickel alloy steels that make Eaton's 2-speed, heavy-duty axles rugged and durable



Slip this ad under your blotter as a reminder.

It illustrates ho a manufacturer – you perhaps – can take advantage of the versatility and true engineering economy of nickel alloy steels.

The picture is a view of an Eaton heavy-duty, 2-speed truck axle. It shows the steels Eaton Manufacturing Company of Cleveland, Ohio, uses to make the many axle types rugged and durable . . . hence economical.

Notice how carefully Eaton selected the steels. Each just right for the part.

Leading manufacturers and users of *super-heavy-duty* vehicles know that it does not pay to skimp on materials in parts such as rear axle drive pinions and ring gears. Use of lower alloyed substitute steels would result in frequent failures and replacements, time lost in the shop, more parts sent to the scrap pile, and more steel and alloys eventually consumed. True economy and efficiency means specifying the most durable and dependable materials for vital truck parts.

Moral of the story: what nickel alloy steels do for Eaton, they can do for you. The address below is another reminder: Inco will provide all possible assistance in selecting the most suitable steels for *your* service.

INCO **THE INTERNATIONAL NICKEL COMPANY, INC.** 67 Wall Street New York 5, N.Y.

AUTOMOTIVE INDUSTRIES

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MARCH 1, 1957 — VOL. 116, NO. 5

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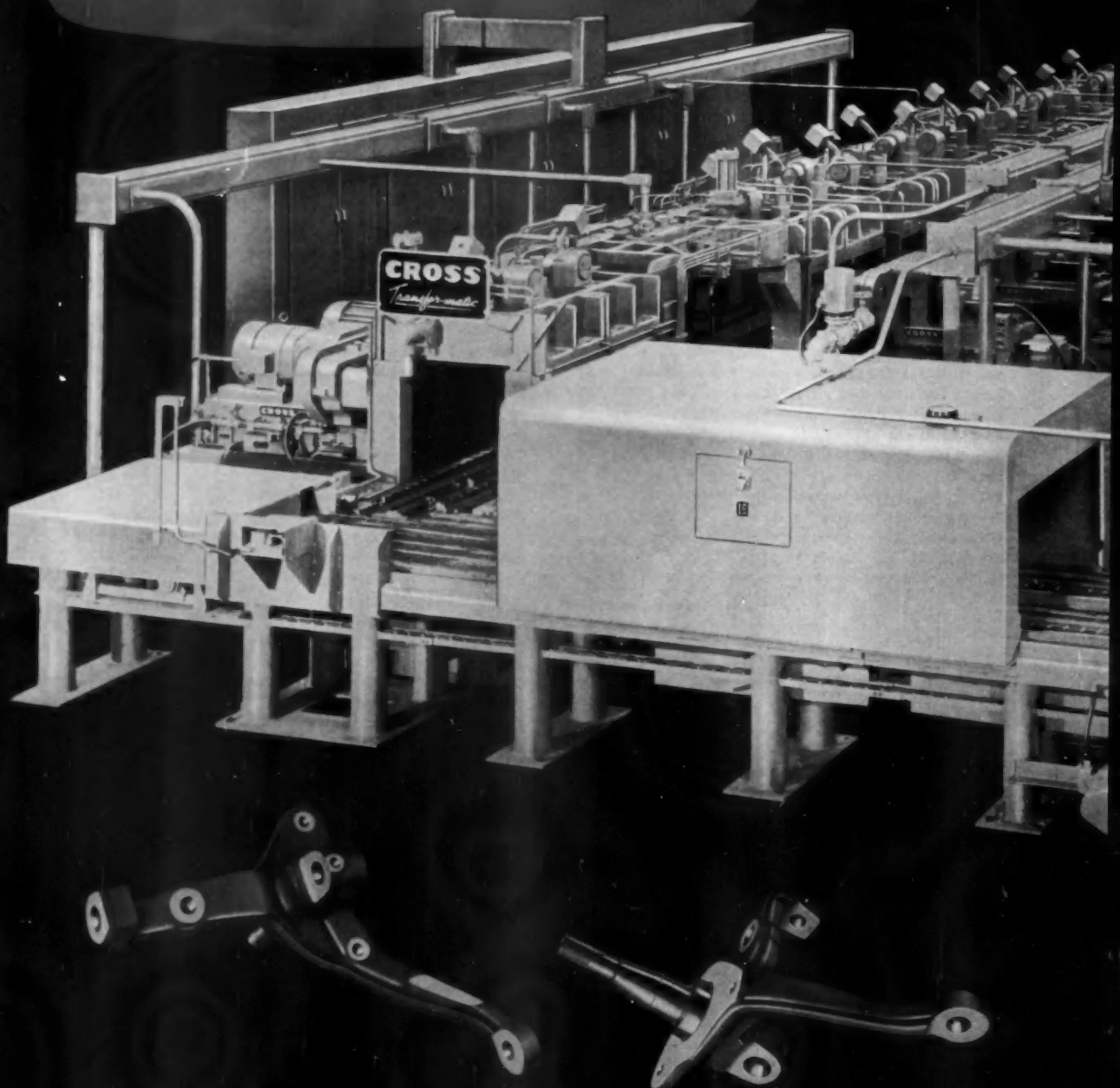

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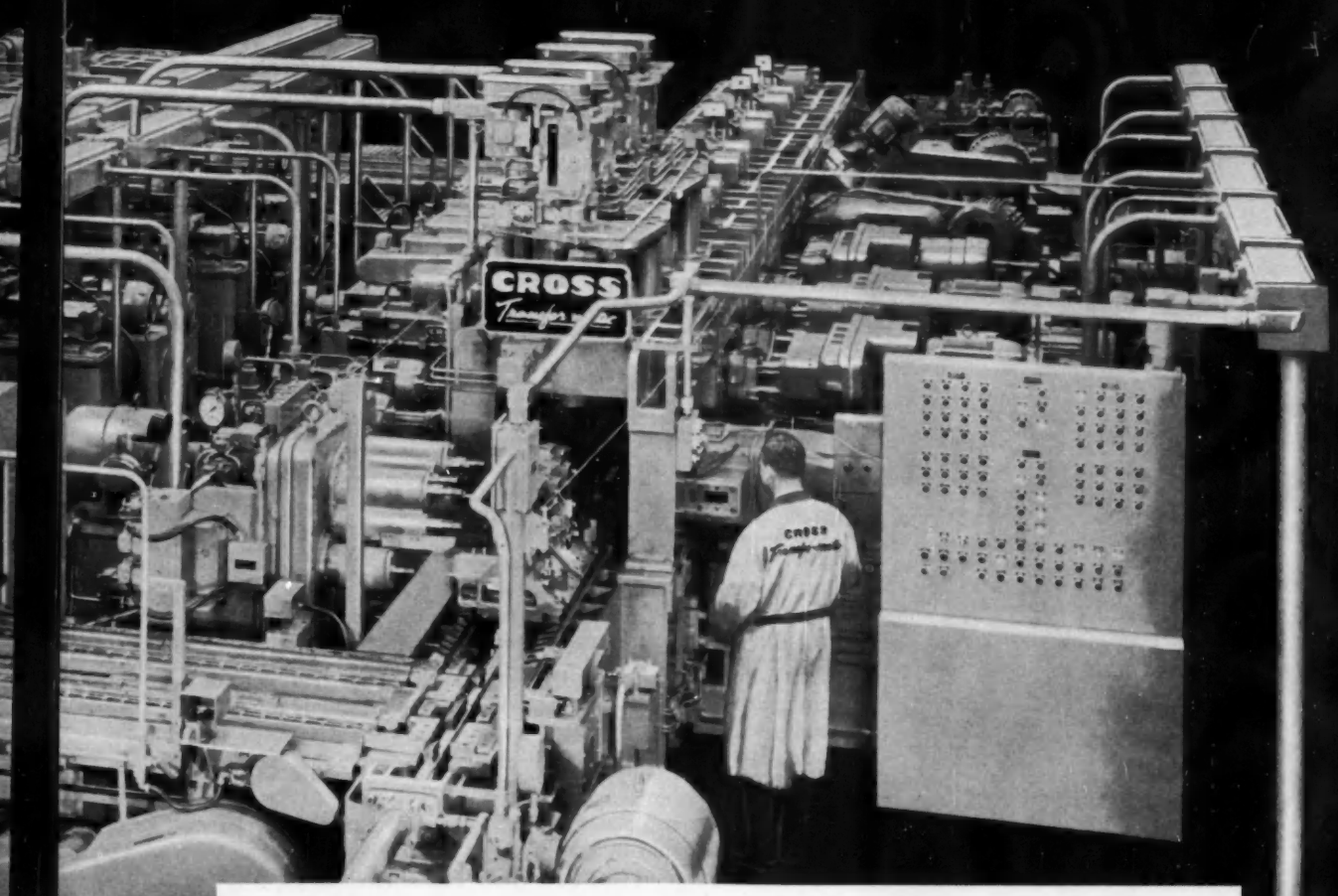

★ Straddle mills upper and lower support arm bosses; straddle mills steering arm boss; mills steering arm stop pad; mills spindle keyway; drills and taper reams upper and lower support arm holes and steering arm hole; drills, reams, chamfers and spotfaces two brake mounting plate holes; drills, counterbores, spotfaces, chamfers and reams brake anchor hole; drills spindle cotter pin hole; and threads wheel spindle.

★ 144 right and 144 left hand parts per hour at 100% efficiency.

★ Pallet type work holding fixtures locate parts from spindle bearing diameters.

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Mallory Silver Rivet Contacts are standardized in 70 stock types and sizes—which means you can count on immediate delivery for pilot run or production.

Mallory's standardization program was built on the results of an intensive study of thousands of silver rivet contact orders. From this survey, 70 basic types were evolved to fit the great majority of applications specified in these orders.

Availability from stock means time saved on orders. Standardization means a wide selection of catalog items, often providing an in-stock item for what might otherwise have been a specially tooled job with its associated higher cost and longer wait.

Dimensions, part numbers, ordering information and pricing data are included in the Mallory folder on silver rivet contacts. Before you place a specially tooled rivet order, why not check the Mallory list for a stock item—and tally up added cost savings on your next production run? Write—or ask the Mallory representative for your copy of Bulletin 3-15A.

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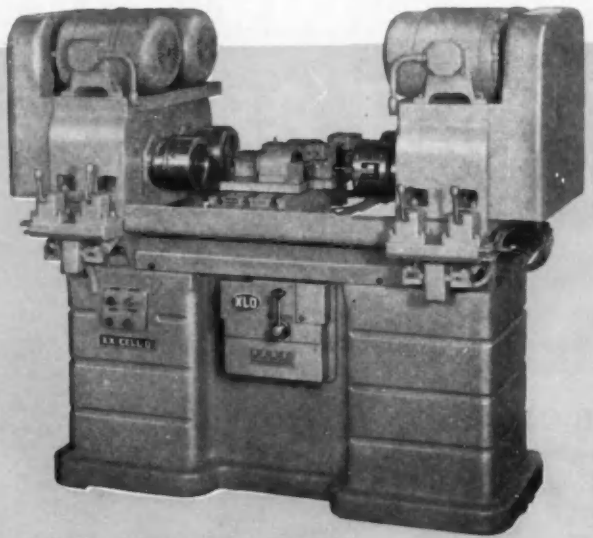
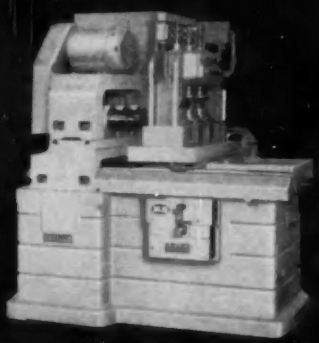
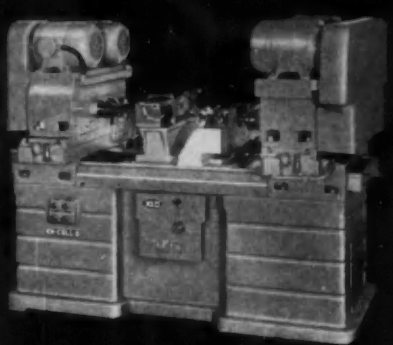


STYLE 1212-B. For identical or different operations at each end. When loading time of parts approximates the time of machining, a double-end machine practically doubles production.

STYLE 2112-B. Single-end model for work pieces in the small and medium-size range. Flexible hydraulic controls give easy adjustment of work cycle.



STYLE 112-D. Large and sturdy with long stroke. Accommodates medium and heavy work, gives maximum precision production, minimum operating cost.



STYLE 17-A. Massive construction. Maintains the highest precision standards on a profitable production basis. Economical in operation, can be tooled for a wide range of production jobs.

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All Standard Ex-Cell-O Precision Boring Machines can be equipped for work handling and ejecting operations, thus providing fast, automatic production at minimum cost.

Contact your local Ex-Cell-O representative who will provide all the facts about these machines, or write to Ex-Cell-O for a precision boring catalog.

57-1

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The solution to the problem was Udylite's Hi-C Bright Nickel Process. By simply changing his 13,000 gallons of bright nickel solution to the new Udylite Hi-C Bright Nickel, the increased production was obtained.

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Why not find out what Udylite's exclusive Hi-C Bright Nickel Process can do for you? Write today for a new free folder describing Hi-C Processes for rack and barrel plating—or call your nearby Udylite representative.

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OF COMING SHOWS AND MEETINGS

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Pressed Metal Institute, annual spring technical meeting, Hotel Carter, Cleveland, O. ..... Mar. 6-8

Pacific Automotive Show, Civic Auditorium, Seattle, Wash.. Mar. 7-10

Atomic Exposition and Nuclear Congress, Convention Hall, Philadelphia, Pa. ..... Mar. 11-15

Association of National Advertisers, spring meeting, Homestead, Hot Springs, Va. ..... Mar. 13-16

National Industrial Conference Board, fifth conference on Atomic Energy, Philadelphia, Pa. ..... Mar. 14-15

Geneva Automobile Show, Switzerland ..... Mar. 14-24

Society of the Plastics Industry, annual national conference and Pacific Coast plastics exposition, Los Angeles, Calif... Mar. 18-21

ASME Gas Turbine Power Conference, Sheraton-Cadillac Hotel, Detroit, Mich. ..... Mar. 18-21

SAE National Production Meeting and Forum, Hotel Statler, Buffalo, N. Y. ..... Mar. 20-22

American Society of Tool Engineers, silver anniversary technical meeting and convention, Shamrock Hilton Hotel, Houston, Tex. ..... Mar. 25-27

Western Metal Congress and Exposition, Los Angeles, Calif.. Mar. 25-29

ASME Engineering Management Conference, William Penn Hotel, Pittsburgh, Pa. ..... Mar. 27-28

American Power Conference, Hotel Sherman, Chicago, Ill. .... Mar. 27-29

SAE National Aeronautic Meeting, Production Forum, and Engineering Display, Hotel Commodore, New York, N. Y. ..... Apr. 2-5

ASME Instruments & Regulators Conference, Northwestern Univ., Chicago, Ill. ..... Apr. 7-10

National Screw Machine Products Association, spring meeting, Shoreham Hotel, Washington, D. C. ..... Apr. 7-11

ASME Spring Meeting, Dinkler-Tutwiler Hotel, Birmingham, Ala. ..... Apr. 8-10

National Packaging Exposition and Conference, Chicago, Ill. ... Apr. 8-11

American Welding Society, national spring meeting and fifth welding and allied industry exposition, Philadelphia, Pa. ..... Apr. 8-12

Conference on Electronics in Industry, Ill. Institute of Technology, Chicago, Ill. ..... Apr. 9-10

Sixth Electrical Engineers' Exhibition, Earls Court, London.. Apr. 9-13

Association of Lift Truck and Portable Elevator Manufacturers, Edgewater Beach Hotel, Chicago, Ill. ..... Apr. 11

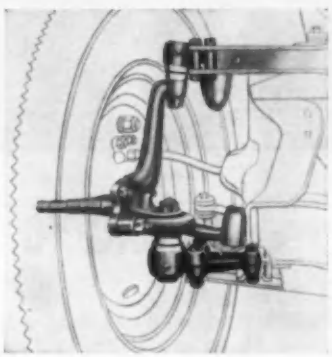
U. S. World Trade Fair, Coliseum, New York, N. Y. ..... Apr. 14-27

National Industrial Research Conference, Conrad Hilton Hotel, Chicago, Ill. ..... Apr. 24-25

Materials Handling Exposition and Conference, Philadelphia, Pa. Apr. 29-May 3

Metal Powder Association, annual meeting and show, Drake Hotel, Chicago, Ill. .... Apr. 30-May 1

Thompson ball joints permit both right and left steering and up-and-down motion of the wheels on ball or spherical bearing surfaces. This advanced front suspension principle not only makes steering safer and easier, it also allows valuable extra space for larger engines; for more functional chassis design for future trends in styling.



Ten cars now feature front suspension ball joints on their sparkling new 1957 models. This advanced Thompson Products engineering improvement helps cars hug the road, makes steering easier and safer.

The development and mass production of this revolutionary new product is a typical example of Thompson's side-by-side cooperation with our customers. For more than 50 years Thompson has been a leading original equipment supplier to the American car, truck and farm implement industries.

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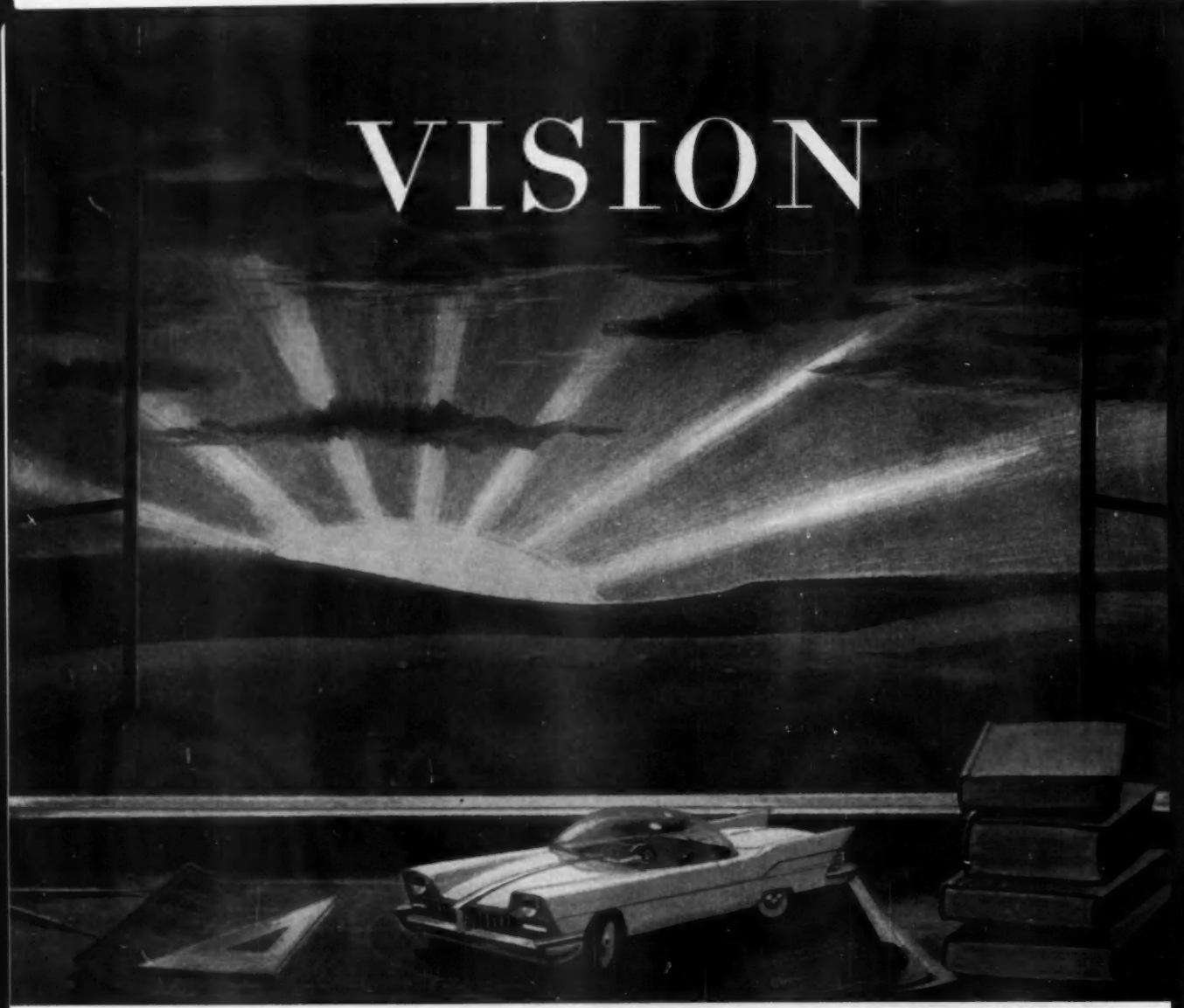

LOOKING TO THE FUTURE—PRODUCING FOR TODAY!

Progress has been the keynote of the automotive industry. Today's achievements are but challenges for the accomplishments of tomorrow.

Over the years Bendix Products Division has contributed significantly to automotive progress. From four wheel brakes to power braking and power steering, Bendix has pioneered and developed many of the industry's most notable advancements.

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That's why the industry looks to Bendix* as a source of new ideas, as well as a volume manufacturer of automotive components.

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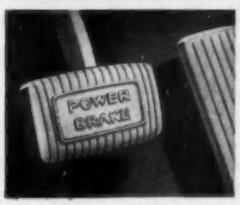

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High Spots of This Issue

Techniques for Using Cutting Fluids at Ford

Playing a vital role in production, cutting fluids have won increasing attention from management in recent years. So important have they become that Ford has developed a number of special techniques for using them, as seen here. Page 26.

Innovations at Chrysler's Nine-Mile Press Plant

One of the outstanding operations of its kind is the facility of Chrysler Corp. known as the Nine-Mile Press Plant. Two of the latest developments highlighted in the article are a coil lifter and an automatic headlamp ring machine. Page 32.

SPI Division Holds Annual Exhibit and Conference

Held in Chicago early last month, the 12th annual Exhibition and Conference of the Reinforced Plastics Div. of the Society of the Plastics Industry was well attended. Presented here in condensed form are papers of automotive interest. Page 36.

New Hydraulic Transmission Features High Efficiency

Developed by Cambi Idraulici Badalini S.p.A of Italy, a new hydraulic transmission with infinitely variable ratios is said to have wide automotive applications. Details of its construction and operation are analyzed for the reader. See Page 44.

Details of Chevrolet Turboglide Transmission

A non-shifting, concurrent-geared, multiple turbine transmission, the Chevrolet Turboglide has dual stator blade control. It has no low gear, and the transmission performance ratio is available at any throttle position, the authors state. Page 46.

34 New Product Items And Other High Spots, Such As:

Milling machine for airfoil surfaces; perspective drawings; new five-speed transmission; German industrial truck; Vauxhall Victor; jet engine parts cast in shell molds; aircraft bearing developments; fire protection at Ford Mahwah plant; What is the best tire cord? and bonding techniques for making trainer.

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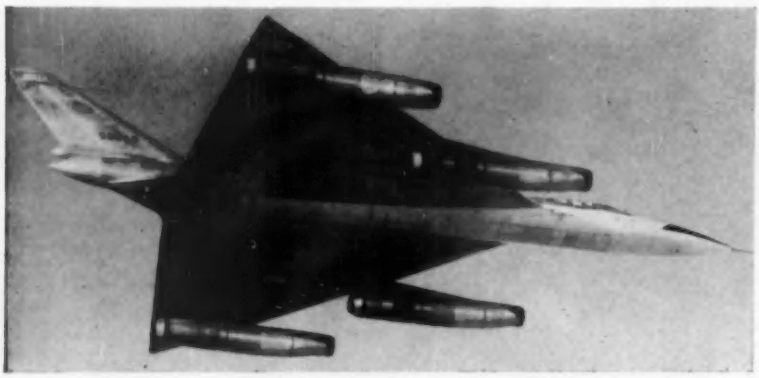


CONVAIR HUSTLER POWERED BY UNDERSLUNG J-79 JETS

This photograph of the Convair B-58 Hustler dramatizes the four powerful General Electric J-79 turbojet engines with afterburners that propel it at supersonic speeds. The new Air Force bomber is about 95 ft long, and its delta wing spans about 55 ft.

Chevrolet and Reynolds Metals To Build Joint Aluminum Units

Reynolds Metals Co. will provide molten metal from a new $88 million aluminum reduction plant adjoining a Chevrolet foundry to be built near Massena, N. Y. The agreement between Reynolds and General Motors reflects the constant growth in the use of aluminum in automotive manufacturing, and the steps being taken by automobile producers to move closer to their sources of supply.

The 213,000 sq ft Chevrolet foundry is scheduled to start operations in June of 1959 turning out aluminum castings for automotive parts. It is the second foundry to be built by GM near an aluminum reduction plant. GM's Fabricast Div. already has a foundry at Jones Mills, Ark., in operation near an aluminum plant.

Ford To Spend $6.7 Million On Old Highland Park Plant

Ford Motor Co's decision to dispose of part of its old Highland Park, Mich., plant is another step in the company's continuous efforts to shift operations to more modern facilities. The move will mark the end of vehicle assembly work at the 50-year-old plant, which pioneered mass assembly of automobiles at the turn of the century.

Although the company will spend $6.7 million to modernize some facilities at the site, a sizable portion of the 144-acre site will be sold. The expenditures will go chiefly for enlarging and modernizing the trim plant. It has been making such items as plastic parts, door grips, and upholstery. Tractor assembly operations also will be modernized.

All production of heavy and extra-heavy trucks will be discontinued in May at Highland Park. These operations will be shifted to one or more of Ford's newer assembly plants. Expenditures at the plant will be spread over the next two years.

Optional Equipment Demand Stays High Despite Prices

Judging by all reports, there appears to be no resistance by car buyers to purchasing optional equipment. Demand for most items continues to increase, despite price hikes posted on many of the options with introduction of 1957 model cars.

Buick, for example, reports record demand for power equipment. Power brakes are being installed on 61.6 per cent of production, compared with 46.4 per cent last year at this time; power steering, 66.2 per cent, compared with 52.2 per cent; and automatic transmissions, 98.4 per cent, compared with 96.7 per cent last year, the report stated.

Applications of Gas Turbines Studied by Detroit IAS Group

Automotive, marine, aircraft, and industrial applications of small gas turbines held the spotlight at a recent meeting of the Detroit Section of the Institute of Aeronautical Sciences.

R. R. Peterson of the Navy Bureau of Ships pinpointed high-speed planes and navy craft as two uses for which small gas turbines are particularly suited. He commented in passing that a free-piston-gas-turbine-engine combination appears to hold great promise in the vehicle field. As far as industrial applications are concerned, Mr. Peterson stated that the lightweight gas turbine is especially practical for portable power.

D. C. Shepherd, professor of mechanical engineering at Cornell Univ., discussed at length the technical aspects of turbine cycles and efficiencies. In spite of the current emphasis on regenerative cycles, he suggested that more attention be given to some means of intercooling to improve cycle efficiency.

Homer J. Wood of H. J. Wood Associates reviewed the many configurations known today in the design of turbines, compressors, and combustors. End use is the main consideration in the design of both a turbojet or gas turbine; but, he said, only the turbojet justifies emphasis upon low frontal area. Therefore, why should axial flow elements be considered either essential or the best solution for gas turbine design?

For the general run of gas turbines, Mr. Wood continued, radial flow turbines and compressors can be used at lower cost. In many instances, such savings can be achieved without sacrificing either weight or efficiency.

Ford of Canada Sales and Net Fell Off Slightly Last Year

Ford Motor Co. of Canada, Ltd., had net income in 1956 of $19,722,043, compared with $20,729,823 in 1955. Net sales were $345,682,670, compared with $346,143,702 the year before.

AND AVIATION INDUSTRIES

'Portable' Air Conditioner Offered For Chrysler Line

MoPar Parts Div. of Chrysler Corp. is offering a car air-conditioning unit as a dealer-installed accessory. While the unit is designed to fit only 1957 Chrysler lines, it can be used on older models with a few adaptations. Cost is around $325, which includes installation time of from three to five hours.

The evaporator assembly weighs 16½ lbs. It is mounted under the instrument panel and is enclosed in a case measuring 15¼ in. long, 7 in. high, and 12½ in. deep.

Compressor is mounted on the engine with the condenser placed ahead of the radiator. A magnetic clutch, which disengages the compressor when the air cooler is not in use, is available at extra cost.

Miehle-Dexter Plans to Make A New Line of Turbochargers

Miehle-Dexter Supercharger Div. is expanding its facilities in an area leased from the J. I. Case Co. in Racine, Wis. The addition will be used initially for research and development of a new line of high-pressure turbo-superchargers for automotive Diesel engines.

The present plant of the affiliated Christensen Machine Co. in Racine will continue to manufacture a line of rotary positive blowers and superchargers. The new line of turbochargers will supplement the present line of superchargers.

The new facility will have complete equipment for testing supercharged engines, in addition to the various test sets for checking and calibrating turbochargers. Special machine tools for building prototypes will also be housed in the area.

Tucker Shareholders May Yet Recoup Some Of Their Losses

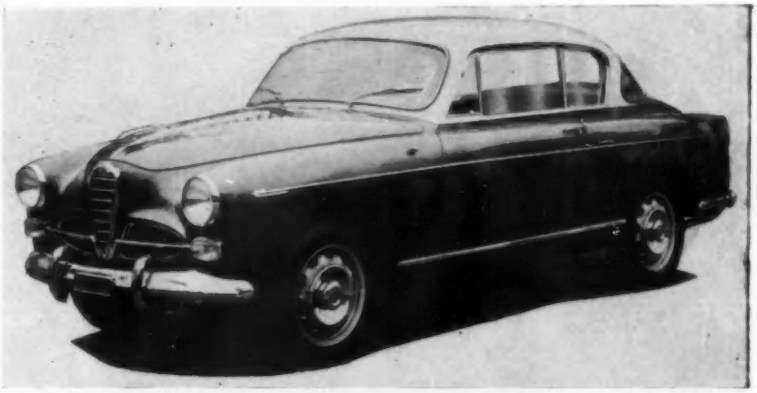
Shareholders of the defunct Tucker Corp. may yet recoup some of the losses they incurred from their investment. One of the reasons making that possible is the Government's concession to reduce its claim against the corporation from the original $6 million to $1.2 million. Another is the possible reorganization of the company under its profitable operating subsidiary, Aircooled Motors, Inc.

Since the U. S. debt is about to be cleared up, only one other major obstacle stands in the way. This is some $2.9 million in claims filed by persons who signed up as distributors and dealers for the Tucker car.

These dealers, however, also owe the corporation approximately $3 million in promissory notes given Tucker Corp. franchises. This matter would have to be settled before any reorganization is possible. The trustee of the bankrupt corporation has indicated he would cancel the notes, if the distributors agreed to drop their claims.

If an amicable agreement is reached, next step would be either to reorganize Aircooled Motors as the surviving corporation and distribute new shares to stockholders, or sell it and distribute the proceeds. Aircooled Motors, which has been engaged in a special testing and development project, had assets totaling $3.27 million at the end of 1956 and liabilities of $505,083.

The company had a net income of $212,891 for the year ended Dec. 31. This was substantially better than in the previous year.



TWO-DOOR ALFA ROMEO SEDAN IS PUT ON MARKET

The new Alfa Romeo 1900 Primavera resembles in many respects the 1900 Super. It is powered by a four-cylinder gasoline engine with an output of 90 bhp at 5200 rpm. Compression ratio is 7.5 to 1 and displacement is 123 cu in. approximately.

Ford To Spend $21 Million On Brazil Truck Operation

Ford truck production in Brazil will more than triple by 1960 under a recently announced $21 million expansion program there. Approximately $16 million of the total outlay will go for new equipment at the Sao Paulo plant. The remainder will be used for acquisition of land and construction of new buildings.

Truck production at the Sao Paulo plant is expected to total 8250 this year. By 1960, output is expected to be raised to 30,000 units a year.

When the expansion program is completed, about 90 per cent of the truck parts will be Brazilian-made, compared with 40 per cent at present. Earlier, General Motors announced it was planning to expand truck production at its Brazilian operation.

Lights In Door Panels Warn Traffic In Rear

An interesting feature of Chevrolet's super show model Corvette may be used in future production cars. Alternating flasher red lights set in the door panels go on automatically, when the door is opened, to warn traffic to the rear. They would probably be offered as an extra-cost option, if sufficient interest is shown.

News of the AUTOMOTIVE

STAINLESS STEEL HELPS COOL TRANSMISSION OILS

Stainless steel coolers for automatic transmission oils will be used for the first time by Ford this year on part of its production. Engineers from Ford and McCord Corp. have been working on the development for two years. Allegheny Ludlum Steel Corp. assisted the two companies in the selection and grade of stainless steel (Type 430). Hot oils up to 300 F are pumped through lines from the automatic transmission to the oil cooler in the bottom tank of the radiator for cooling and return to transmission.

Reo Gets $3½ Million Contract For V-8 Engines

Reo has bolstered its truck business with a $3½ million order for engines to be used by Studebaker-Packard in military trucks. Delivery of the V-8 engine is to be spread through 1957.

Ford Local 600 Employes Are Put on 30-Hour Week

Whether the 30-hour work week put into effect recently by the big Ford Local 600 for its office and maintenance employes will set a pattern is debatable at present. The agreement covers only 34 workers, who elected to go on a shorter work week in lieu of a wage increase. One of the motivating factors was the fact that the local is shrinking in size.

A 30-hour work week for 40 hours' pay has long been one of the chief goals of the UAW. The proposal is certain to come up again at the union's national convention in Atlantic City in April.

Dissatisfied with the Supplemental Unemployment Benefit plan, the UAW also will begin a drive for improvements in this program. Its next aim will be to extend the 26-week maximum SUB payments to a full 52 weeks.

SUB payments so far have been kept at a minimum, chiefly because automobile manufacturers have been gearing production schedules carefully with sales demand. Car companies have been extending overtime from regular eight-hour shifts when needed, rather than putting on second shifts. The risk of possible mass layoffs during slack periods has thus been reduced.

Future Truck Transportation Discussed by St. Louis Panel

What does the future hold for truck transportation on the nation's highways? Several answers to this interesting question were given at a manufacturer-consumer panel discussion held in conjunction with the recent annual convention of the Private Truck Council in St. Louis.

William L. Cook of Diamond T. Motor Car Co. discussed the current and future use of new lightweight materials. Included were the use of alloy steels for frame side members and aluminum for frame cross members, spring hangers, engine, transmission, and axle components. He also stated that lubrication should be eliminated whenever possible through the use of rubber both as bushings and load bearing members in rear suspensions. Substantial reduction in wear points by the use of spherical bearings and nylon sleeves could be effected, he said.

Other new manufacturing procedures, such as the use of porcelainized exhaust manifolds, new designs in "tilting cabs," rubber load cushions and air chambers to replace steel springs, and torque converter drives, also were discussed.

A. Vance Howe of Fruehauf Trailer Co. said that only a few years ago trailers were limited to carbon steel. Today, however, stainless steel, aluminum, and combinations of aluminum and steel, and plastics are used.

New transportation developments such as "piggyback," "fishyback" and "boxyback" also were discussed, as well as the use of new types of insulating material.

Life of Buick Glove Box Light Increased By Changing Socket

Buick claims that it has solved the problem of light bulb failures in glove compartments by merely relocating the socket. The company noted that when the 12-volt electrical system was first adopted, bulbs failed quickly. The finer filaments in the bulb tended to jar loose when the glove compartment door was slammed. By changing the location of the socket, light bulb life has been increased appreciably.

AND AVIATION INDUSTRIES

GM Sales and Income Figures Reflect Lower '56 Car Sales

While its sales exceeded $10 billion for the third time, net income of General Motors Corp. in 1956 declined to $847,396,102 from the record $1,189,477,082 of 1955. Profit in 1956 was 7.8 per cent of the $10,796,442,575 sales figure, against the 9.6 per cent profit on 1955 sales of $12,443,277,420.

The year 1956 was GM's second best for unit sales. Total sales of vehicles produced in U. S., Canadian, and overseas plants were 4,091,000 units. A total of 3,508,000 cars and trucks came from U. S. plants.

Testing of Gas Turbine Engines Stepped Up by Big Three Makers

Vehicles powered by gas turbine engines appear to have moved a step closer to realization in the light of stepped-up testing programs announced by the Big Three automobile manufacturers.

Both Chevrolet and Ford disclosed that they are testing gas turbine engines on an experimental basis in heavy trucks. Chrysler announced

Discussing the engine of Chevrolet's new experimental gas turbine truck are the two engineers largely responsible for its development. They are Harry F. Barr, Chevrolet chief engineer (left) and William A. Turenen, head of the Gas Turbine Research Dept. of General Motors.

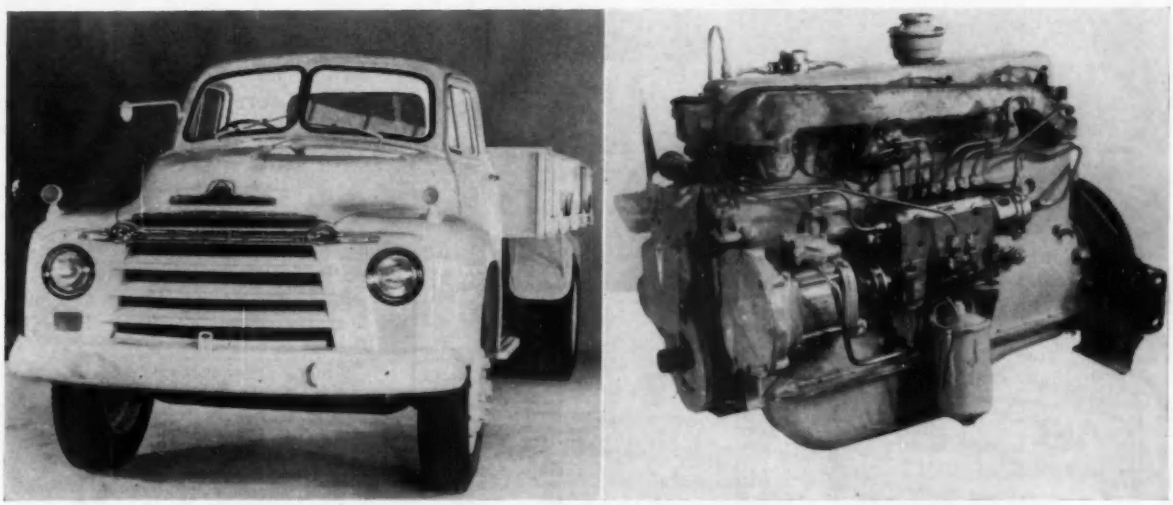
that it is doubling laboratory space devoted to research on automotive gas turbines and piston engines and increasing its total research staff by 20 per cent.

Dubbed the Turbo-Titan, the Chevrolet gas-turbine-powered truck (see illustration) combines a tandem-axle tractor chassis with an improved version of the GM Research Staff's Whirlfire engine. The power plant is similar to the one developed in 1955 for the Firebird II passenger car. The 200-hp engine with a fuel saving regenerator is an experimental unit rather than a production prototype.

The Turbo-Titan's engine is coupled to a conventional Chevrolet tandem truck drive train, including a slightly modified Powermatic transmission. The regenerator in the aircooled engine is a rotating porous metal drum that carries heat from the hot exhaust gas to the relatively cool compressed incoming air.

The Ford gas turbine engine has been installed on an experimental basis in a 1957 tilt-cab truck and is operating at the company's truck testing center at Romulus, Mich. Ford engineers were said to be working at top speed to increase the engine's fuel economy.

In order to expand its engine research programs, Chrysler Corp. has leased the former Waters Manufacturing Co. plant at 12843 Greenfield Rd. in Detroit. This will make available 67,000 sq ft of space for research laboratories and test facilities.



VAUXHALL OFFERS ITS FIRST DIESEL-POWERED TRUCK ON MARKET

Vauxhall Motors, Ltd., has introduced a new Bedford six-ton truck powered by a Diesel engine of 300 cu in. displacement. The six-cylinder power plant develops a maximum of 97 bhp at 2800 rpm and a torque of 271 lb ft at 1400. Bore is 3⅞ in.; stroke, 4¼ in., and compression ratio, 17 to 1. There is direct injection with semi-toroidal combustion chambers recessed in the aluminum alloy pistons, and slip-fit dry cylinder liners are used. Camshaft and auxiliaries are driven from helical timing gears, while a rotary exhauster for vacuum brakes is tandemed with the fuel pump. The new truck is made in four models, and 300 cu in. and 214 cu in. gasoline engines are offered in addition to the Diesel power unit. Many Diesel components are common to the 300 cu in. engine.

News of the AUTOMOTIVE AND AVIATION INDUSTRIES

Glen Alden Reveals Plan for Maremont Acquisition

Details of a proposed plan whereby Glen Alden Corp. will acquire the major assets and substantial earnings of Maremont Automotive Products Co., Inc., were disclosed at a press conference in New York City last month.

Glen Alden will acquire major physical assets of Maremont, having a total book value of $10,661,000. for approximately $3,400,000 in Glen Alden stock and cash. A new Glen Alden subsidiary will also assume $4,266,000 of Maremont liabilities.

Included in the purchase price will be 250,000 shares of Glen Alden stock valued for the purposes of the acquisition at $10 per share, plus $900,000 in cash. The assets to be acquired include Maremont's business, name, management, receivables, inventories, machinery and equipment.

The new Glen Alden subsidiary, to be named Maremont Automotive Products, Inc., will operate the businesses being acquired from the present Maremont Co. It will also lease from Maremont 552,724 square feet of plant and office space on a long-term net lease.

The present Maremont Automotive Products Co. after the transaction is completed, will change its name to Maremont Investment Co. Its assets will consist of $3 million in cash and securities, 250,000 shares of Glen Alden stock, and four wholly-owned plants.

As a condition of the acquisition, Glen Alden shareholders will be asked to approve an increase in the size of its board from seven to 12 members. Elected to the expanded board will be five top officials of Maremont.

The acquisition proposal will be voted on by shareholders of Glen Alden at a meeting in Wilkes-Barre, Pa., on March 12. Maremont shareholders will vote on it at a meeting in Chicago on March 13.

1957 WEEKLY U. S. MOTOR VEHICLE PRODUCTION

As reported by the Automobile Manufacturers Association

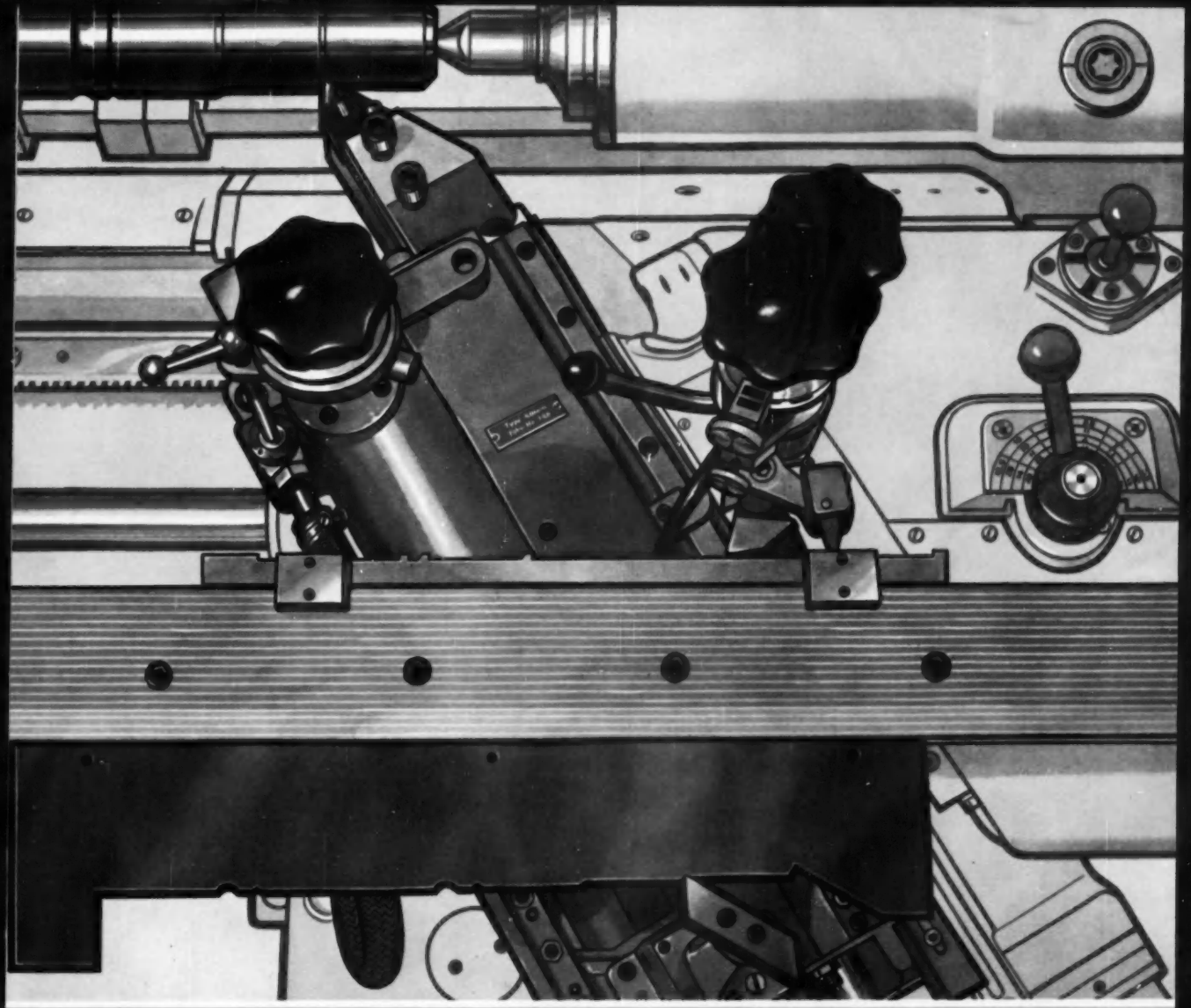
Make	For Weeks Ending Feb. 16	Feb. 9	Feb. 2	Total—Jan. 1 to— Feb. 16, 1957	Feb. 18, 1956
PASSENGER CAR PRODUCTION					
Hudson	37	47	0	389	1,983
Nash	155	131	0	877	5,272
Rambler	2,102	2,007	0	9,450	18,129
Total—American Motors	2,294	2,185	0	10,696	25,384
Chrysler and Imperial	4,200	4,336	4,153	27,220	20,344
De Soto	3,565	3,849	3,848	24,450	18,548
Dodge	6,715	6,588	6,549	42,635	33,611
Plymouth	16,904	16,650	14,102	99,081	78,242
Total—Chrysler Corp.	31,384	31,421	28,652	193,386	150,743
Ford	33,663	33,303	32,340	226,640	196,280
Lincoln and Continental	983	1,237	1,415	8,636	9,330
Mercury	7,880	8,223	7,597	54,568	35,798
Total—Ford Motor Company	42,526	42,763	41,352	289,844	241,408
Buick	11,063	11,626	11,600	79,685	105,612
Cadillac	2,972	3,356	3,444	22,097	22,986
Chevrolet	33,748	33,763	34,211	225,428	248,881
Oldsmobile	10,349	10,413	10,083	68,230	81,255
Pontiac	9,449	9,873	9,652	62,553	61,484
Total—General Motors Corp.	67,581	69,131	68,990	457,993	520,228
Packard	520	536	574	3,211	4,211
Studebaker	1,182	1,053	919	7,135	20,360
Total—Studr.-Packard Corp.	1,702	1,589	1,493	10,346	24,571
Checker Cab	205	44	76	504	85
Total—Passenger Cars	145,692	147,133	140,563	962,769	962,419
TRUCK PRODUCTION					
Available	8	0	6	30	36
Chevrolet	7,796	7,568	7,000	50,053	53,868
G.M.C.	1,438	1,423	1,508	10,583	13,737
Diamond T	77	78	90	541	658
Divco	80	80	80	525	681
Dodge and Fargo	1,899	1,826	1,862	11,844	11,510
Ford	8,312	7,742	7,739	41,112	45,411
F.W.D.	26	25	26	167	195
International	1,373	1,370	1,256	13,281	21,039
Mack	402	414	413	2,556	2,580
Reo	72	68	72	428	509
Studebaker	251	239	236	1,057	2,234
White	345	343	342	2,250	2,849
Willys	1,962	1,600	1,997	10,171	8,787
Other Trucks	72	60	85	512	809
Total—Trucks	24,113	22,876	23,213	145,710	169,901
Buses	106	47	68	479	511
Total—Motor Vehicles	169,911	170,056	163,844	1,108,958	1,132,831

Many Future Developments to Be Debated at SAE March Meeting

Air springs, rear-mounted engines, new finishes, suspensions, and components will be among the subjects up for discussion at the forthcoming SAE National Passenger Car, Body, and Materials Meeting. It is scheduled to be held March 5, 6, and 7 at the Sheraton-Cadillac Hotel in Detroit.

Among chairmen of sessions for presentation of technical papers will be: J. T. O'Reilly, Ford Motor Co.; R. I. Schonitzer, Schonitzer Engineering Co.; H. L. Hartzell, General Motors Corp.; J. W. Grieg, Woodall Industries, Inc.; F. R. McFarland, General Motors Corp.; R. P. Lewis, Dana Corp.; and C. A. Rasmussen, General Motors Corp.

Continued on Page 19



New Britain +GF+ outproduces multi-tool lathes with a single tool

How can one tool outproduce several? The answer is — maintain dimensional relationships with a template or prototype instead of a multi-tool setup. This cuts tool changeover time to practically zero.

On the New Britain **+GF+** copying lathe, you can cut at maximum speeds and feeds for tool efficiency without worrying about tool wear and the delicate readjustment of several cutting tools. When the tool wears, change it, bring one dimension to size. The other dimensions have to be right. Your choice of a New Britain **+GF+** means elimination of any extra operation to bring pieces within grinding tolerances.

Machines from New Britain's three machine tool divisions incorporate the *basic principles* of more profitable production.

THE NEW BRITAIN MACHINE CO.

New Britain +GF+
Copying Lathe

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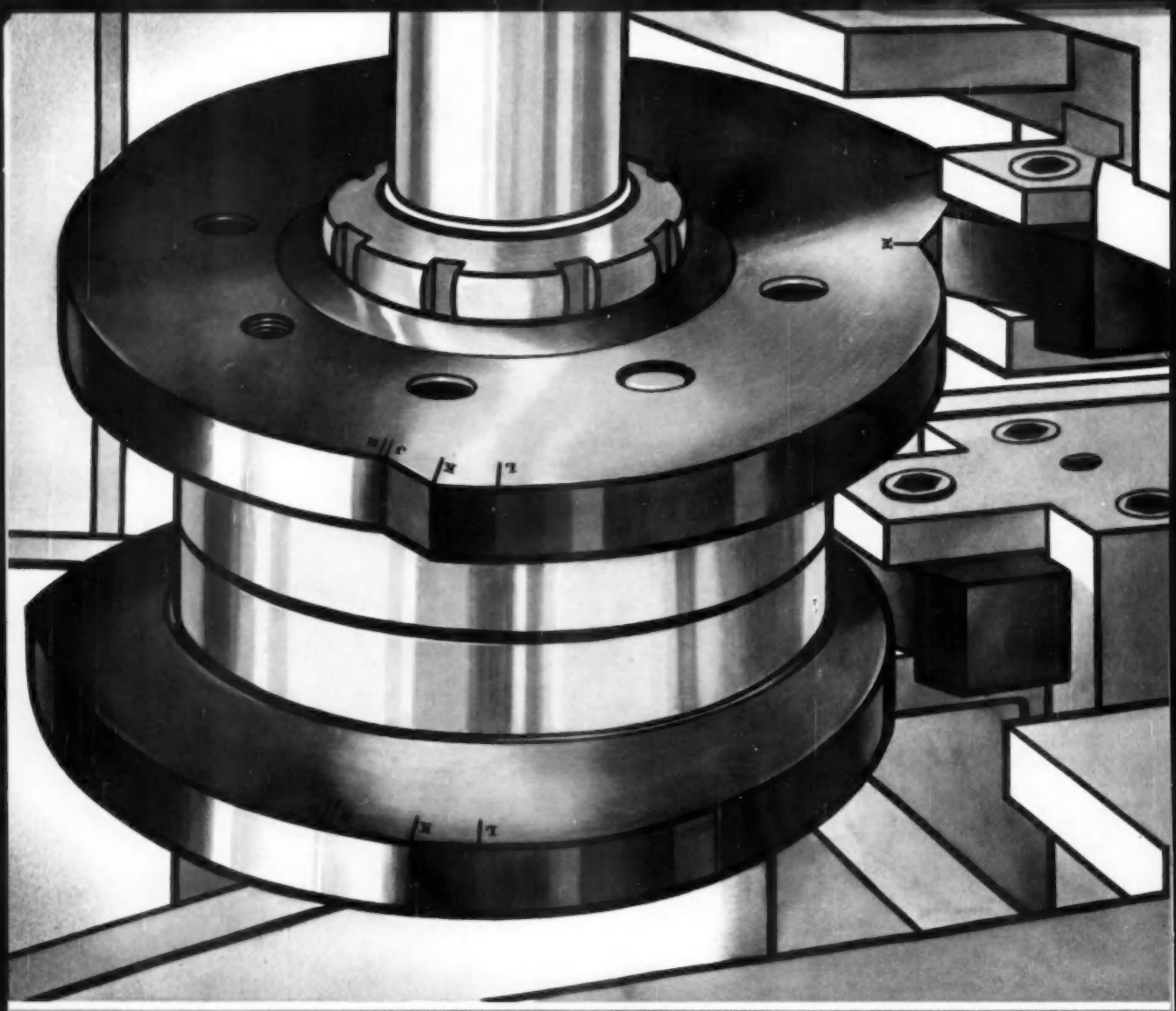


cams put the precision in precision boring

When you are working to "tenths" cams are your best method of maintaining accuracy, because cam control of the tool is *positive* control. The accuracy of parts produced on New Britain boring machines *can't* be affected by variable hydraulic pressures, ambient temperature, or play in complicated linkages.

In boring machines or *any* machine tool investment, be sure your most important requirements are met, not by gadgets, but by the fundamental design principles employed. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

THE NEW BRITAIN MACHINE CO.
Precision Boring Machine
NB

News of the AUTOMOTIVE AND AVIATION INDUSTRIES

Continued from Page 16

ROLLER-HEARTH FURNACE

Many separate operations in the heat-treating of large aluminum-alloy extrusions are eliminated in a new application of a roller-hearth furnace built by Westinghouse Electric Corp. Quality of the end product is also improved at the Halethorpe, Md., plant of Kaiser Aluminum Co. Extrusions are brought to a 103-ft charging table by conveyor; charge doors raise automatically and extrusions go into the 112-ft furnace at the rate of 50 fpm. The furnace has a maximum operating temperature of 1000 F, and a total rating of 7.5 million Btu per hour.

Ethyl Adding Calif. Plant For Anti-Knock Compounds

Ethyl Corporation is constructing its fourth plant for the production of anti-knock compounds for internal combustion engine fuel. Located in Pittsburg, Calif., the new facility is slated for completion about the middle of next year and will be in operation shortly thereafter.

Military Automation Show Postponed Until Next Year

The Military Automation Exposition, scheduled for New York City's Trade Show Building March 18 through 21, has been postponed until June 9 through 13, 1958. It will be held simultaneously at the Coliseum with the Fourth International Automation Exposition.

AI TABLOID

American Motors Corp. plans to add station wagons to its Nash and Hudson lines for 1958.

* * *

Plans have been dropped for the time being to merge Vertol Aircraft Corp. and Northrop Aircraft Corp.

* * *

Continental-Diamond Fibre Div. of The Budd Co., Inc., has changed its name to Continental-Diamond Fibre Corp.

* * *

Hiller Helicopters has been awarded an Air Force contract for development of tilt-wing aircraft.

* * *

Du Pont Co. will build a new sulfuric acid plant on the Detroit River at Ecorse, Mich.

* * *

Thompson Products, Inc., has broken ground for a new Research and Development Center near its Euclid, O., plant. . . . Piper Aircraft Corp. will set up an engineering development center at Vero Beach, Fla.

* * *

Sharon Steel Corp. has opened a new $14 million slabbing and blooming mill at its Roemer Works.

* * *

Mack Trucks, Inc., is offering a new torque converter drive on two types of fire pumpers.

* * *

Solar Aircraft Co. is developing a new type of 1000-hp gas turbine called the Saturn with widespread application for small boat propulsion.

* * *

Westinghouse Electric Corp.'s capital spending of some $75 million in 1957 will be aimed at improving existing plants, rather than building new ones.

Moraine Products Div. of General Motors Corp. has assembled its 1,250,000th power brake unit for automobiles.

* * *

Bell Aircraft Corp. has acquired Lake Erie Engineering Corp.

* * *

Goodyear Tire & Rubber Co. has set up a new subsidiary to conduct its foreign business. It is incorporated as The Goodyear International Corp. and replaces The Goodyear Tire & Rubber Export Co.

* * *

Aeroproducts Operations of the GM Allison Div. has announced a $1 million building expansion program.

* * *

General Electric Co. has developed a new material called Borazon that rivals the diamond in hardness and exceeds it in heat resistance.

* * *

Kaman Aircraft Corp. has received a Navy research and development contract for a new utility helicopter.

* * *

Westinghouse Electric Corp. has formed a new X-ray and Industrial Electronics Div. at Baltimore, Md. . . . United Aircraft Corp. has placed its nuclear engine activities in a separate unit of the Pratt & Whitney Aircraft Div.

* * *

General Electric Co. has in pilot plant production a tiny battery with a projected life of more than 20 years.

* * *

Temco Aircraft Corp. has developed a new process that is said to effect considerable savings in the fabrication of titanium.

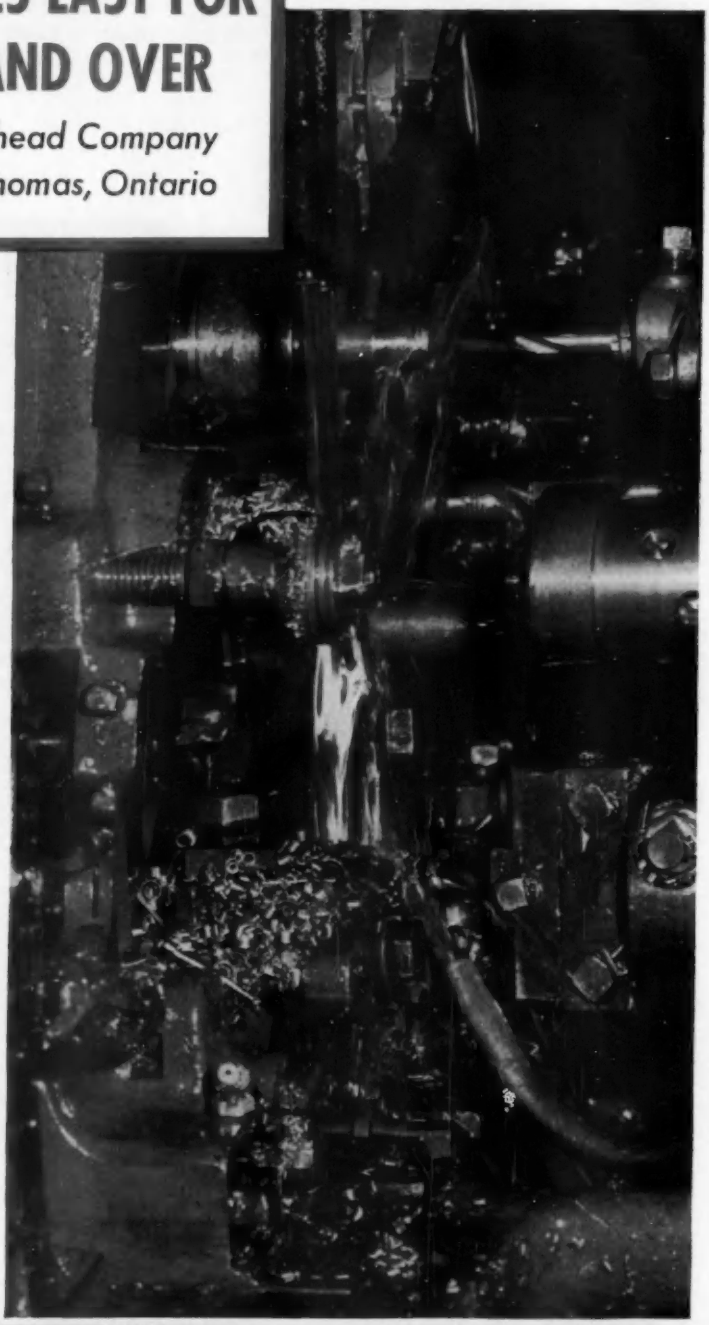
* * *

DuPont Co. will build its third plant for manufacturing titanium oxide near New Johnsonville, Tenn.

Formerly only 15,000:

NOW THREAD ROLLS LAST FOR 100,000 PIECES AND OVER

. . . reports Weatherhead Company of Canada, St. Thomas, Ontario



The job is making ⅛" pipe plugs of B 1113 steel. Work is done on Davenport automatics, and the threads are rolled on.

Using a competitive brand of cutting oil, Weatherhead had been getting only about 15,000 pieces between roll changes and found excessive wear on form tools and drills. Seeking improvement, Weatherhead tested other brands of cutting oil including *Texaco Cleartex Oil B*.

Results with *Texaco Cleartex Oil B* were so vastly superior that it was quickly adopted for production runs. That was five years ago. Since then, Weatherhead has been getting a roll life of 100,000 pieces, and greatly increased life for all tools.

Texaco Cleartex Oil B is only one of the complete line of Texaco Cutting, Grinding and Soluble Oils designed to help you do all your machining better, faster and at lower cost. A Texaco Lubrication Engineer will gladly help you select the proper ones.

Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, N. Y.

Texaco Products are distributed in Canada by McColl-Frontenac Oil Company Limited, Montreal

TEXACO

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CUTTING, GRINDING, SOLUBLE AND HYDRAULIC OILS

TUNE IN . . . METROPOLITAN OPERA RADIO BROADCASTS EVERY SATURDAY AFTERNOON

Men in the News

Vickers, Inc.—J. F. Forster was appointed executive vice - president.

National-Standard Co.—**Thomas H. Pearce** was elected executive vice-president.

ACF Industries, Inc.—**William T. Taylor** has been elected chairman of the board.

Warner Electric Brake & Clutch Co.—**Norman K. Anderson** was named vice-president and general manager of the Industrial Div., and **King DeSeve** was made vice-president and general manager of the Automotive Div.

International Nickel Co., Inc.—**Maurice J. Phillips** has been appointed advertising manager.

Zollner Corp.—**Blayne W. Osborne** was elected executive vice-president.

Lear, Inc.—**Andrew F. Haiduck** has been named executive vice-president.

Wellman Bronze and Aluminum Co.—**Paul W. Hook** has been made executive vice-president and treasurer; **Glenn F. Ihring**, vice-president in charge of sales; and **Gene Faubel**, assistant sales manager.

Chrysler Corp.—**Kenneth C. Butterfield** has been appointed staff master mechanic.

AC Spark Plug Div., General Motors Corp.—**Glen R. Fitzgerald** was appointed chief automotive engineer, and **John A. McDougal** was named assistant chief engineer in charge of the instrument group.

Kearney & Trecker Corp.—**Morris L. Hutchens** was named vice-president in charge of engineering; **Herbert Whitney**, chief metallurgist; and **Charles Parske**, chief engineer of the General Engineering Dept.

Pontiac Motor Div., General Motors Corp.—**C. H. Collins** has been appointed plant engineer.

Manhattan Rubber Div., Raybestos-Manhattan, Inc.—**Charles P. McHugh** has been appointed director of research and product design.

Rochester Products Div., General Motors Corp.—Adolph F. Braun has been named to succeed Elmer Olson as chief engineer. The latter has been promoted to director of engineering and sales.

A. O. Smith Corp., Automotive Div.—**R. A. Wendorf** has been named sales manager.

Bohn Aluminum and Brass Corp.—**Gerald V. Kingsley** has been made director of research.

Convair Div., General Dynamics Corp.—**B. F. Coggan** was elected vice-president and manager of Convair-San Diego, and **Charles F. Horne** was elected vice-president and manager of Convair-Pomona.

Bullard Co. — Clifford H. Hagberg is now assistant sales manager.

Bundy Tubing Co.—**P. A. O'Connell** was named vice-president in charge of sales; **C. L. Palms, Jr.**, vice-president in charge of industrial relations; **W. F. Kendall**, general sales manager; and **A. F. Bernthal**, advertising and sales development manager; **G. D. Baker** and **David Rust** were elected to the board of directors.

Mercury Div., Ford Motor Co.—**J. B. Howard** is now resident plant manager at the St. Louis plant; **George O. Keutgen**, assistant manufacturing manager (production); and **Lowell E. Krieg**, assistant manufacturing manager (production engineering).

General Motors Corp.—**John M. Campbell** and **Arthur F. Underwood** were named scientific director and manager of staff activities, respectively, for the Research Staff.

Studebaker - Packard Corp.—Duncan McRae has been named director of styling.

Necrology

Harry W. Barkley, 52, president and general manager of National Tool Co., died recently, at Cleveland, O.

Leland D. Albin, 81, retired vice-president of Ingersoll-Rand Co., died Feb. 12, at St. Petersburg, Fla.

W. E. C. Clifford, 74, chairman of the board of Clifford-Jacobs Forging Co., died recently, at Champaign, Ill.

Marshall W. White, 71, former director of public relations and personnel at the Chevrolet Tarrytown, N. Y., plant died Feb. 5, at White Plains, N. Y.

Frank W. Judson, 83, retired vice-president of Pittsburgh Plate Glass Co., died Feb. 8, at Pittsburgh, Pa.

Burton A. Howe, 71, a former director of Willys-Overland Motors, Inc., died Feb. 12, at Delray Beach, Fla.

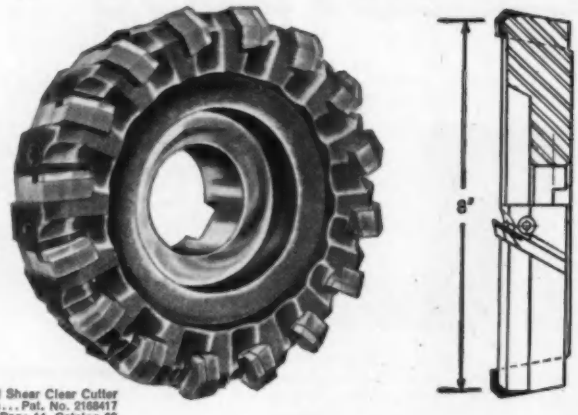
Samuel B. Kingham, 55, assistant executive vice-president of accounting for U. S. Steel Corp., died Feb. 10, at Bridgeville, Pa.

Joseph F. Ross, president of J. J. Tourek Mfg. Co., died Feb. 2, at Chicago, Ill.

Ray L. Howard, 61, veteran of the automotive and aviation industries and sales engineer for Dana Corp., died recently, at Butler, Ind.

Laurence Gauthier, 38, manager of the Chemical and Metallurgical Engineering Dept. of the Ford Livonia, Mich., plant, died Feb. 1, at Livonia, Mich.

George L. Nankervis, 59, president of George L. Nankervis Co., died Feb. 13, at Detroit, Mich.



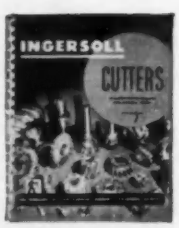
Ingersoll Shear Clear Cutter
27000 series... Pat. No. 2168417
Page 14, Catalog 66

Feed rate increased 2½ to 5 times at Vaughn with this INGERSOLL SHEAR CLEAR® CUTTER

The cutter previously used was nullifying the investment in a new standard, knee-type milling machine. The machine had more power than was being utilized. The feed rate was only 12″ per minute. The change to Ingersoll Shear Clear permitted the Vaughn Machine Company, Cuyahoga Falls, Ohio, to capitalize on its machine investment and obtain the economy and efficiency of increased feed rate. A feed range of 30″ to 60″ per minute, when milling rough forgings and steel castings, is now continuously maintained.

Ingersoll inserted blade cutters are used on all makes of machines for milling and boring a wide range of materials. An Ingersoll Cutter Division representative will be glad to discuss this and other feed rate experiences with you.

Whether you are concerned with feed rates, longer tool life, finish or cutter costs, the new Ingersoll cutter catalog will be a valuable guide. Write Department 66I.



Use this new 82 page guide for selecting the right inserted blade milling and boring cutters for your work. Write for catalog 566, today.

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AMERICAN MACHINE & FOUNDRY CO.

AMERICAN MOTORS CORP.

BRIDGEPORT BRASS COMPANY

BROWN & SHARPE MFG. CO.

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CLEARING MACHINE CORPORATION

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KAISER ALUMINUM & CHEMICAL CORP.

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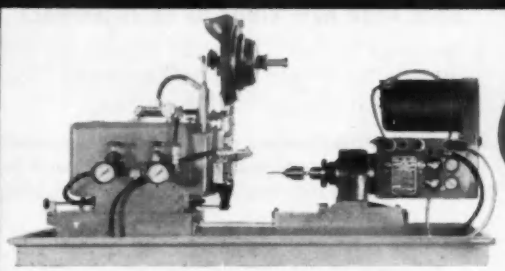
VAUXHALL

CUTTER DIVISION

THE INGERSOLL MILLING MACHINE COMPANY

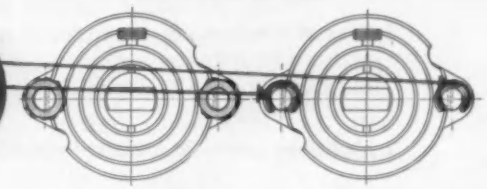
ROCKFORD ILLINOIS

Waldes Truarc Retaining Rings Eliminate Machining and Parts—Cut Assembly Time on Drill and Tapper



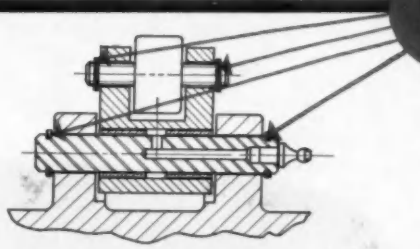
Beco Model 410 Drill and Tapper

The Batchelder Engineering Co., Inc., Springfield, Vermont uses 4 different sizes of 2 different type Waldes Truarc rings in their new BECO Model 410 Automatic Drill and Tapper. Truarc rings speed assembly, reduce machining, improve design.



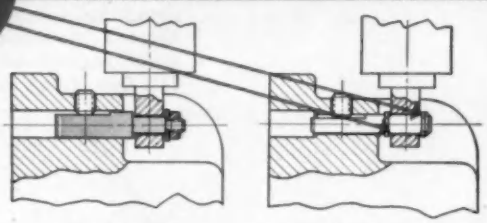
Clamp Cylinder Rod Stop Assembly

Truarc "E" Rings (Series 5133) replace stop nuts in the Clamp Cylinder assembly. They eliminate need for threading 2 rods ...the danger of cross-threading nuts...and costly rejects. Truarc Rings cut assembly time and cost.



Bell Crank Pivot Assembly

Truarc Rings (Series 5100) in Bell Crank Pivot assembly permit grease hole not possible with cotter pin fastener. Use of nuts would have increased machining and assembly costs considerably.



Hopper Cylinder Anchor Pin Assembly

2 Truarc Rings (Series 5100) secure and position end of vertical air cylinder. Rings eliminate extra cost of machining 3-diameter pin, threading and undercutting...plus nut and washer. Assembly is quick and sure.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types...as many as 97 different sizes within a type...5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

More than 30 engineering-minded factory representatives and 700 field men are available to you on call. Send us your blueprints today...let our Truarc engineers help you solve design, assembly and production problems...without obligation.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool!

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AY-639

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,202; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787, and other U. S. Patents pending. Equal patent protection established in foreign countries.

Plymouth gains three production advantages

Plymouth Division of Chrysler Corporation sees these important advantages in its new headlamp doors made of aluminum:

1. **Low cost of aluminum** over other materials.
2. **Ease of fabrication**—aluminum's easy workability cuts manufacturing costs...eliminating steps both in material preparation and final finishing.
3. **Light weight**—less than half as much as other metals—reduces shipping, handling and assembly costs.

ADDS FOUR NEW KINDS OF SALES APPEAL!

1. **Natural beauty** . . . *solid* aluminum will always be bright and attractive because there's no plating to chip or peel.
2. **Easy maintenance**...just a light water-wash cleans it like new—there's never a need for hard "rust-removing" scouring or scrubbing.

Plymouth's attractive new headlamp doors—made of aluminum—are supplied by Electro-Mechanical Products Company and The Electric Auto-Lite Company.

with headlamp door of aluminum

3. **Long-life durability**... cannot rust... is corrosion resistant... helps preserve trade-in value with its permanent "new look."

4. **Practical styling**... aluminum permits both *decorative and functional* shapes and patterns not feasible with other metals.

This headlamp door is an outstanding example of how Kaiser Aluminum is helping to bring better parts at lower cost to the automotive industry. Our Automotive Development Division is available to work with you as "idea partners"... as well as to help you on any specific requirements or problems on aluminum alloy selection and fabrication.

* * *

For further information, phone our Automotive Industry Division at TRinity 3-8000 in Detroit. Kaiser Aluminum & Chemical Sales, Inc., 2214 Fisher Building, Detroit 2, Michigan.

Kaiser Aluminum

See "THE KAISER ALUMINUM HOUR." Alternate Tuesdays, NBC Network. Consult your local TV listing.

Advanced Techniques for Using

CUTTING fluids practice has made major advances in recent years, primarily through a recognition by management that these materials play a vital role in production. They have an important part in the manufacturing scheme, exerting an influence upon tool life, dimensional control, surface finish quality, and productivity.

Enormous quantities of cutting fluids of all kinds

TABLE 1—FORD CUTTING FLUID RECOMMENDATIONS

Type of Material	Automatic Screw Machines	Boring, Milling, Profiling, Chucking	Broaching	Drilling	Gear Cutting	Gear Shaving	Hand Screw Machines & Lathes	Threading and Tapping	Honing	Grinding	Thread Grinding
Carbon Steels	S-CL MO, 1 - 9	W Sol O 1 - 24	S-CL MO, 1 - 5 or W Sol O	W Sol O 1 - 24	S-CL MO, 1 - 9 or W Sol O 1 - 24	S-CL FO	W Sol O 1 - 24	S-CL MO, 1 - 9	S-CL FO + Seal Oil, 1 - 9	W Sol O 1 - 60 or S MO	S-Cl FO + . O, 1 9
Alloy Steels	S-CL MO, 1 - 9	W Sol O 1 - 24	S-CL MO, 1 - 5 or W Sol O	W Sol O 1 - 24	S-CL MO, 1 - 9 or W Sol O 1 - 7	S-CL FO	W Sol O 1 - 24	S-CL MO, 1 - 9	S-CL FO + Seal Oil, 1 - 9	W Sol O 1 - 60	L FO + MO, 1 - 9
Stainless Steels	S-CL MO, 1 - 5	S-CL MO, 1 - 5 or W Sol O	S-CL MO, 1 - 5	S-CL MO, 1 - 5 or W Sol O		S-CL FO	S-CL MO, 1 - 9	S-CL FO or S-CL FO + MO, 1 - 9	S-CL FO + Seal Oil, 1 - 9	W Sol O 1 - 60	S-CL FO + MO 1 - 9
Steel Castings		W Sol O 1 - 24	S-CL MO, 1 - 5 or W Sol O	W Sol O 1 - 24	S-CL MO, 1 - 9 or W Sol O 1 - 7	S-CL FO	W Sol O 1 - 24	S-CL MO, 1 - 5	S-CL FO + Seal Oil, 1 - 9	W Sol O 1 - 60	S-CL FO + MO 1 - 9
Cast or Malleable Iron		W Sol O 1 - 24 or dry	W Sol O 1 - 24	W Sol O 1 - 24	W Sol O (Syn) 1 - 40	S-CL FO	W Sol O (Syn) 1 - 40	W Sol O (Syn) 1 - 40	S-CL FO + Seal Oil, 1 - 9	W Sol O (Syn) 1 - 40	S-CL FO + MO 1 - 9
Aluminum	S-CL FO, 1 - 19	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40	S-CL FO + Seal Oil, 1 - 9	W Sol O (Spec) 1 - 40	W Sol O (Spec) 1 - 40
Copper and Copper Alloys	MO	W Sol O 1 - 40	W Sol O, 1 - 24	W Sol O 1 - 40	S-CL MO, 1 - 9, or W Sol O 1 - 24	W Sol O 1 - 24	W Sol O 1 - 60	MO	MO Seal	W Sol O 1 - 60	MO, 1 - 40
Magnesium	MO	MO or Dry	S-CL MO, 1 - 9	MO or Dry	MO	MO or CO_2	MO	MO	S-CL FO + Seal Oil, 1 - 9	MO	MO
Zinc		W Sol O 1 - 10	W Sol O 1 - 10	W Sol O 1 - 10	W Sol O 1 - 10	W Sol O 1 - 40	W Sol O 1 - 24	W Sol O 1 - 24	S-CL FO + Seal Oil, 1 - 9	W Sol O 1 - 60	W Sol O 1 - 60

Materials and blends in the table, using the ASTM key designation:

1. **(W Sol O) Standard soluble oil, petroleum base. Recommended for all general applications.**
2. **(W Sol O) (SP) Special purpose soluble oil, petroleum base.**
3. **(W Sol O) (Syn.) Special purpose soluble oil, synthetic type.**
4. **(MO) Mineral cutting oil—recommended for all general applications where soluble oil cannot be used due to machine design or job requirements.**
5. **(MO) (seal) Mineral seal oil is used as a base for honing oil.**
6. **(S-CL FO) Fatty cutting oil, sulpho-chlorinated.**
7. **(EP) Extreme pressure oils—include:**
   (S-CL FO) sulpho-chlorinated lard oil. (S-CL MO) sulpho-chlorinated mineral oil. (S-FO) sulfurized lard oil.
8. **(S-CL MO, 1-9) Standard mineral cutting oil, sulpho-chlorinated. This is a blend of nine parts MO and one part of S-CL MO.**
9. **(S-CL FO, 1-9) Special purpose mineral cutting oil. It is a blend of 9 parts of MO and one part (S-CL FO).**
10. **(S-CL FO MO, 1-9) Special purpose mineral honing oil — sulpho-chlorinated — blend of 9 parts (MO-seal) and one part of (S-CL FO).**
11. **(S-MO) Special purpose mineral oil—sulfurized, for grinding hardened parts.**
12. **(S-CL MO, 1-X) Mineral blending oil is mixed with MO in various proportions.**

Cutting Fluids at Ford Motor Co.

BY
JOSEPH GESCHELIN

are consumed by plants in the automotive industries. Ford alone consumes petroleum soluble oil concentrate at the rate of 750,000 gal per year. This does not take into account the other kinds of cutting fluids, consumed at a lower rate but totaling a considerable added gallonage in the course of a year.

At Ford, central control of practice in the utilization of cutting fluids is in the hands of the Process Development Department, a branch of the Manufacturing Engineering Office.

Key to the most effective utilization of cutting fluids at Ford is found in the development of standard specifications for a minimum number of basic materials. In turn, these selected materials are keyed to specific operations and materials as outlined in Table 1. This is, in effect, a general summary of recommendations for specific operating conditions. The information in the table thus serves as a starting point for the selection of a cutting fluid for any new operation.

This does not imply that selection of the right kind of material for a unique chip removal problem is rigid or inflexible. Any plant in the Ford organization can request exceptions to the standards. Such exceptions may stem from the need for some special cutting fluid; or to take advantage of some exceptional properties that may be inherent in a new product. In such cases, however, Process Development reserves the right to subject a special brand product to critical examination. For example, cutting fluids are subjected to prescribed machinability testing for comparison with accepted specification materials. Tool wear tests are another criterion of acceptance. Invariably samples are subjected to actual shop trial; and study by the industrial health department to rule out toxicity.

If a competitive material appears to have promise, Process Development will authorize production testing for a period of say 60 days to determine acceptability. The point is that new developments are encouraged. Contact made through the central purchasing department or the purchasing department of one of the plants will be routed directly through to Process Development for study. Thus the door is always open for new developments from any direction.

The variety of cutting fluids is held to the most practical minimum. As a matter of fact, the company has standardized on the following five distinctive types of materials:

1. Petroleum base soluble (emulsifiable) oils.
2. Straight mineral oils.
3. Fatty oils, including sperm oil.
4. EP type oils.
5. Blends of two or more of the materials, items 2 to 4.

With these basic products as a starting point, a group of blends has been selected to cover the major requirements of the various plants in the organization. Here and there are a few specialized jobs which may require a different cutting fluid, as mentioned earlier. Such cases, however, are never standardized unless more than two plants find it necessary to employ the same kind of material.

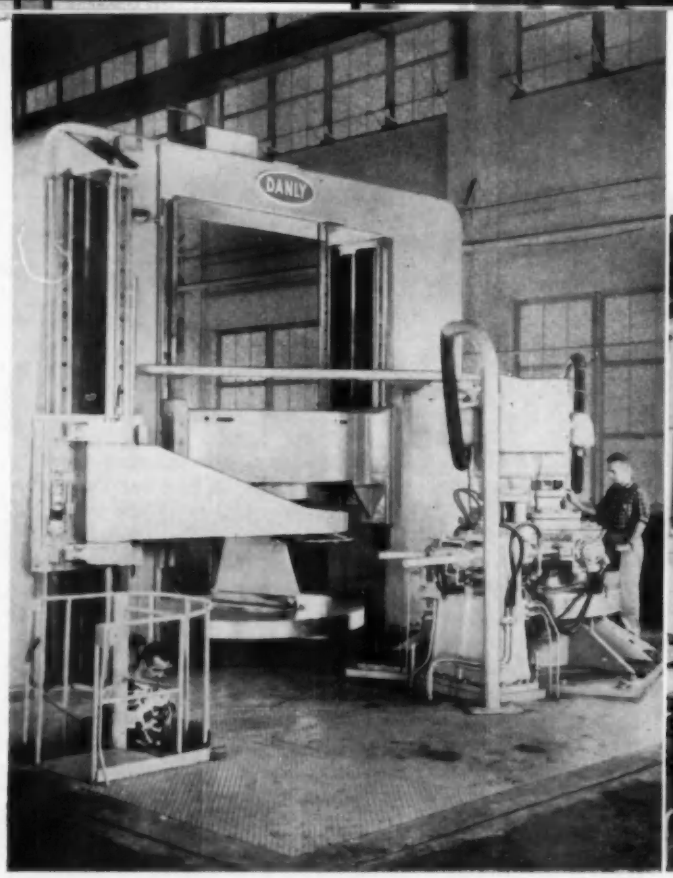
Table 1 provides a generalized scheme of recommended cutting fluids for specific applications, taking into account the types of machine tools, cutting tools, and ferrous as well as non-ferrous materials. This is intended primarily as a guide and a starting point. It represents the results of years of experience, tempered constantly by new developments. It recognizes that, in specific cases, it may be necessary to modify the recommendation either by changing the degree of dilution or by shifting to some other kind of cutting fluid. As explained earlier, in the latter event, Process Development takes a hand in determining whether a new type of cutting fluid is acceptable.

In actual practice the standarized cutting fluids are identified by specification numbers. A key identification which follows the recommended practice of Tech. Comm. K of ASTM wherever possible, is employed exclusively in Table 1.

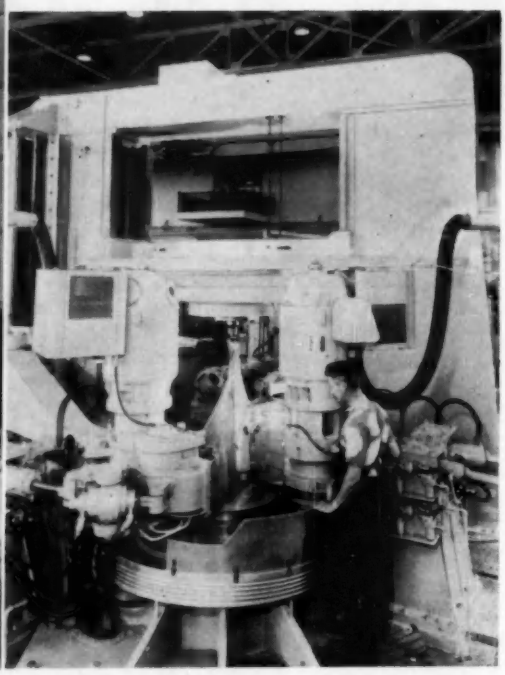
It may be noted in passing that Ford utilizes central coolant systems in its various plants where practical. The basic system consists of a detention tank for primary filtration, velocity trenches, conveyors, and necessary process piping and pumps. Filters are used for secondary filtration where necessary.

The central system offers several distinct advantages which are enumerated below:

1. It provides a central point for maintaining coolant quality and provides a central point for checking bacterial growth, which in turn helps to minimize waste treatment problems.
2. A central system provides a convenient point from which to gather coolant for disposal and is also a central point to which new coolant can be supplied.
3. The central system insures cleaner machines and helps to reduce maintenance costs.
4. It insures better coolant quality and thereby promotes better work quality.
5. It minimizes the amount of manual work in disposing of chips and grinding sludge, which is the basis of a chip handling program.



Above-the-floor view of airfoil milling machine. Between the uprights is shown revolving table, wooden master of complex airfoil shape and follower wheels. Airfoil surface is generated by follower wheels through hydraulic system to setup at right.



Close-up of airfoil milling machine showing two milling cutters in action on an airfoil shape.

Huge Automatic Machine for Milling Airfoil Surfaces

A 150-TON airfoil milling machine, largest device of its kind ever constructed, is now in use by the National Advisory Committee for Aeronautics' Ames Aeronautical Laboratory, at Moffett Field, Calif.

This unique machine tool is capable of sculpturing in metal the complex shape of an airplane's wing or the twisted blades of an axial flow air compressor. The only one of its kind in existence, it was developed and built to the requirements of the Federal Government research center by Danly Machine Specialties, Inc.

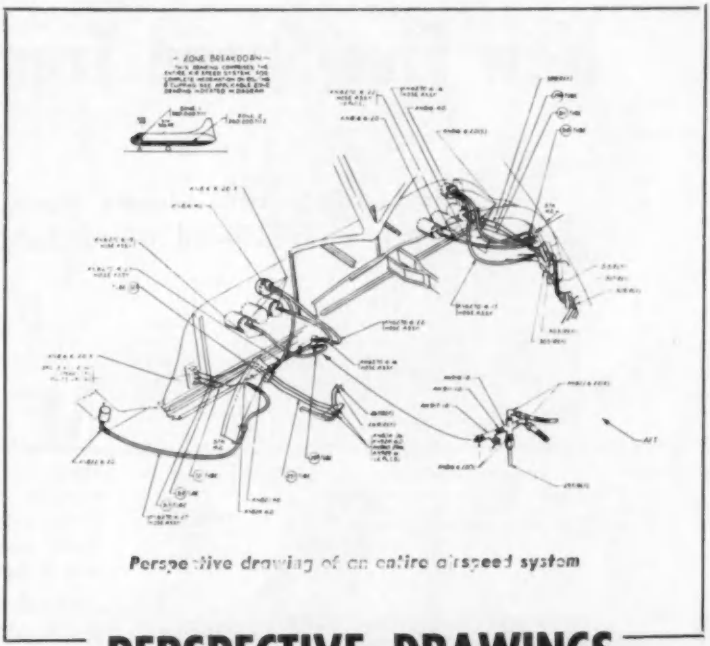
Airfoil mills are essentially machines for duplicating in metal a complex curved shape generated by tracing a prepared pattern. In the Danly airfoil milling machine, a wooden pattern is mounted vertically on a circular revolving table. Two large tracer wheels are held in contact with the pattern; and, as the table revolves, the relative motion of the tracer wheels is transmitted to two cutters. The cutters are positioned against the metal blank to be machined, and the blank also revolves at the same speed as the pattern. In this way, the cutters shape the metal blank to the same curve as the wooden pattern.

The action of the Danly machine is fully automatic, once the pattern and workpiece have been put in place. The device is capable of machining a shape 18 by 18 by 96 in. long; or 8 by 26 by 96 in. long. The mechanism that holds the metal blank can exert an upward thrust of 8500 lb.

Both pattern and workpiece on the Danly machine are mounted vertically, in contrast to previous airfoil mills of horizontal design. This mounting method eliminates any bending that might result from the weight of the metal blank.

A large part of the machine is housed in a pit be-

Turn to page 76, please)



Perspective drawing of an entire airspeed system

PERSPECTIVE DRAWINGS

Facilitate Wiring and Tubing Installation

By Russ Johnson, Group Engineer
Convair (San Diego)
A Division of General Dynamics Corp.

THE complicated installation of thousands of tubes and wires in today's modern aircraft is a formidable task even for highly trained engineers and technicians.

The preparation of the drawings to accomplish the job is difficult, too. Convair engineers, after careful study, decided that the solution to the problem was to supply shop installation personnel with blueprint which would reproduce the installations as they actually existed.

As a result of that decision, the isometrics group was organized and has since been producing the pictorial type installation drawings used in the fabrication of all production models at San Diego. The plan also has been introduced at the Convair Fort Worth Division.

The term isometrics is a misnomer, for the drawings currently being produced are perspectives. The name is commonly used, however, because earlier drawings were based on the isometric principle of equal measurement.

The Convair mock-up program, of which these drawings are a part, smoothes out many a rough spot by providing a fix on items which cannot be clearly defined at the design level.

Proofing of wiring and tubing is accomplished in an accurate metal facsimile of the production model by first installing all required equipment. Tubes and wires are then added, using tubing flow diagrams and electrical circuit and connection diagrams as a guide. Engineers and inspectors maintain strict surveillance over this phase of the design and upon completion are responsible for giving the mock-up their stamp of approval. The isometrics group moves into the picture after approval, to make the perspective drawings of the installations.

The sketches are prepared at the mock-up by a few draftsmen who have a flair for illustrations of this type. These preliminary drawings are a composite of all tubing or wiring in the area being recorded and are later broken down into systems. The original drawings are always made on reproducible paper.

The prints, which are made from the reproducible sketches, are used by other departments as advance information. They are also used by engineering in preparing final drawings, and can be traced by draftsmen with little or no illustration experience. This eliminates the need for a large group of specialists.

Final drawings are separated into two major categories—tubing or wiring. The method used in preparing tubing drawings varies slightly to accommodate installation procedure.

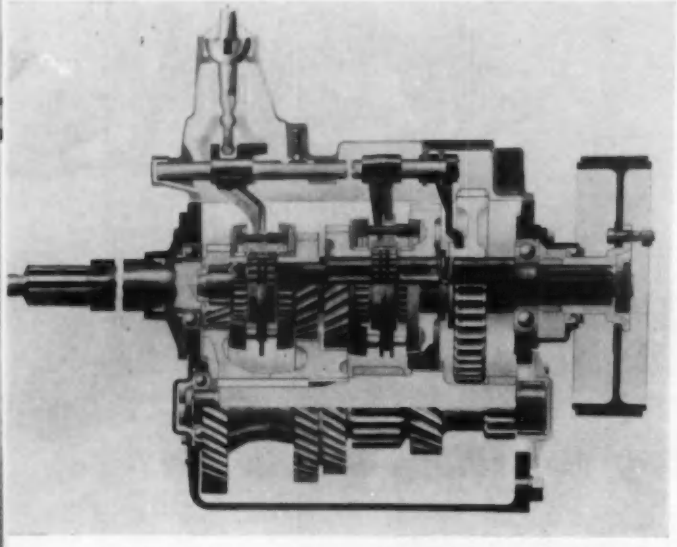
For aircraft in which tubing can be installed in large, pre-assembled banks two types of drawings are used. First, a drawing is prepared for each of the separate tubing systems, such as hydraulic, airspeed, fuel, etc. This type of drawing accounts for all tube assemblies and connecting fittings and provides a picture of the complete system. Actual installation, however, is accomplished by a second drawing which calls for attaching parts, such as clips, clamps, and other required hardware. Installation drawings, or clipping drawings as they are generally called, are patterned as nearly as possible after the breakdown of shop work areas. They provide a picture of the tubes for all systems in the banks in which they are installed.

For those aircraft models in which tubes are installed as separate items because of weight and space

(*Turn to page 82, please*)

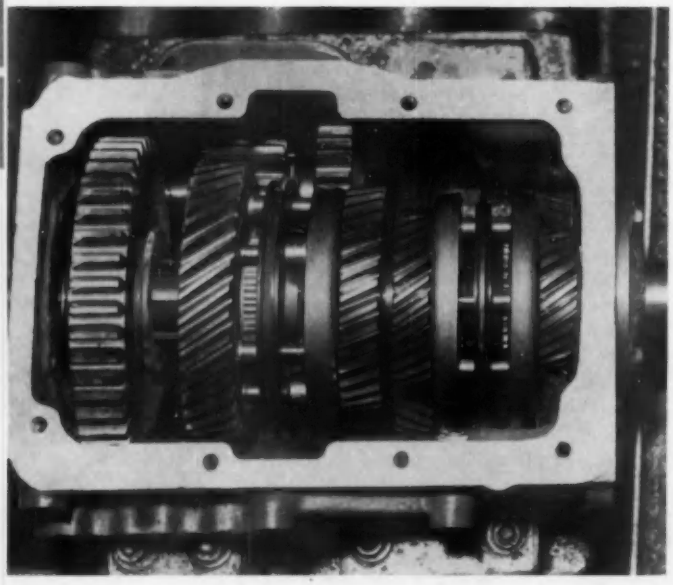
New Five-Speed Transmission

Six Leading Truck Makers Have Adopted New Unit which is Offered in Four Ratio Combinations



Sectional view of the New Process five-speed manual 540 transmission.

Top view of new transmission with cover removed



MANY lines of medium trucks are available this year with a new fully synchronized manual transmission. This new unit, designed and built by New Process Gear Corp., has been adopted by six leading truck makers—Dodge, Chevrolet, Studebaker, General Motors, Ford, and International Harvester.

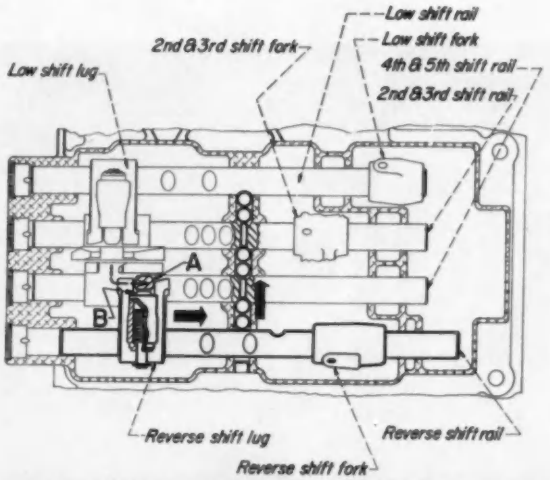
Called the 540, the transmission has five forward speeds and one reverse. The top four gears are synchronized and there is a double power take-off provision.

By using a sliding idler gear which does not require the low reverse slider to be moved for reverse engagement, lengths of the case, mainshaft and countershaft are reduced by 1½ in. This saves 20 lb and increases shaft rigidity. A die cast aluminum cover, used for the first time on any high production, five speed truck transmission, saves another 15 lb. Aluminum is also used for weight saving in the countershaft rear bearing retainer. A further economy in the cost of material is achieved by using pearlitic malleable forks, except for the 4 to 5 shift.

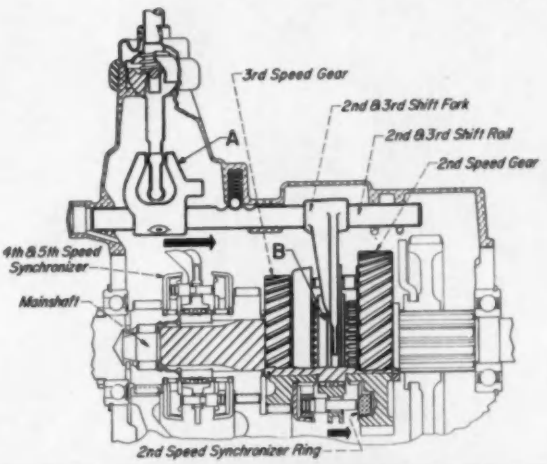
In line with efforts directed at quieter operation, helical gears are utilized in all but low and reverse. A 33⅓ deg helix angle is used with the exception of the 3rd gear where shaving cutter clearance dictated a 23½ deg helix angle.

Full fillet radii and shot peening, well known aids to fatigue life, contribute to high capacity in a relatively small space with low weight. With the same goal in mind, the needle bearing at the rear of the countershaft is pressed into a die cast aluminum retainer. Synchro rings in the 540 transmission are die cast aluminum with pre-hardened steel blocking pins cast directly into the ring.

Jumping out of gear is prevented by a "Torque-Lock" feature in the four gears. Two grooves are cut in each clutch gear and the teeth on either side of these grooves are shaved thinner than the teeth remaining in the center. The overall length of the sliding clutch is properly proportioned with the length of shift to allow the thicker teeth to act as a lock when the clutch is loaded. In low gear the problem is minimized by locating the gear adjacent to the rear transmission wall, where high loads can be carried with minimum deflection and misalignment.



Shifting mechanism of the 540 transmission, illustrating shift from neutral into reverse
(A) — Lower ball (B) — Plunger



Side view of the fully synchronized transmission showing the shift into second
(A) — 2nd-3rd shift lug (B) — Sliding clutch

A unique application of the "splash" technique helps provide efficient lubrication. The Model 540, using synchronizers and sliding clutches rather than sliding gears (except for low and reverse), must have these gears free to rotate on a shaft at one time or another during operation. The bearings must, therefore, be capable of operating under heavy loads, with efficient lubrication essential not only when the gears run freely on the shaft, but also to prevent fretting corrosion when one of the gears is clutched to the shaft.

Extra wide overhanging countershaft gears throw oil through openings in the gear hubs onto the mainshaft journals. The bearings of the three gears are steel on steel with lubrication augmented by the use of cam ground, fluted oil passages.

The main shaft's pilot needle bearing is lubricated through slots in the drive gear shaft between the gear and the front bearing. Oil is slung from the front of the offset countershaft gear, through these slots, onto the mainshaft pilot extension which leads to the pilot rollers.

A bayonet lock on the shift lever retainer permits palletizing the transmission during shipment. It also reduces the total number of different assemblies required by the transmission manufacturer since various levers can be shipped separately.

Synchronization

The New Process pin-type synchronizer used in the Model 540 consists of an outer stop ring, which is a steel plate (or gear) carrying a ground internal cone; an inner stop ring, a die-cast aluminum ring with threaded exterior conical surface which mates with the outer stop ring cone; and a sliding clutch. The inner stop ring has three pre-hardened stepped pins cast into it parallel to the cone axis and pointing in the opposite direction from the apex of the projected cone. The "step" in the pins is chamfered, and matching chamfers are machined into the holes in the sliding clutch through which the pins pass. These holes are large enough to permit the larger diameter of the pin to enter, but in the neutral position, only the small end of the pins project into the holes. The sliding clutch is splined to the mainshaft of the transmission, so that it rotates whenever the vehicle is in motion.

The synchronizer is activated by moving the shift rail and fork, the fork being engaged with the sliding clutch at all times. The resultant motion of the sliding clutch causes the chamfers around the pin holes to engage the chamfers on the pins.

Since the sliding clutch is rotating whenever the truck is in motion, and can only drive the inner stop ring when the pins are in contact with the pin holes, the cones on the inner and outer stop rings are forced together with a resultant frictional force. In this way, the outer stop ring and its gear are brought

(*Turn to page* 86, *please*)

540 TRANSMISSION RATIO TABLE

Gear	Direct in 5th		Overdrive	Range Box
	Set #1	Set #2		
1	6.06	7.40	6.06	3.70
2	3.31	4.05	3.31	2.02
3	1.84	2.40	1.84	1.62
4	1.16	1.48	1:1	1.27
5	1:1	1:1	0.82	1:1
R	6.42	7.85	6.42	3.92

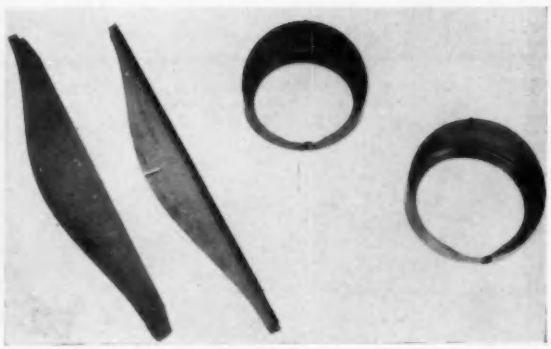
Note: The Range Box is specifically designed with close step ratios to work in conjunction with a wide-spread two-speed rear axle having a step of approximately 2.5:1.

◀ FIG. 1

C-F electronic type coil lifter recently introduced in the Nine-Mile Press Shop

FIG. 2A

▼ Principal steps in producing the headlamp ring



Innovations at Chrysler's Nine-Mile Press Plant

UNQUESTIONABLY one of the outstanding operations of its kind, Chrysler Corporation's Nine-Mile Press Plant boasts a number of innovations of interest. This article highlights two of the latest developments.

Probably a "first" in this area is the electronic, remote control sheet or coil lifter. As illustrated (Fig. 1), this is a toggle-type heavy duty tong rated at 20-ton capacity. A number of these packages have been installed on the existing P & H 20-ton cranes serving the steel receiving bay. There is nothing new in the principle of handling coils by means of tongs. But this mechanism, apart from remote control, is unique in design, and features a very minimum of dimensional displacement when the tong is fully opened to grasp or release a coil.

The significance of this can be best appreciated by press shop management since every large consumer of sheet metal is faced with the same serious problem of storage space. Employment of the C-F coil lifter makes it an easy matter to store coils of any size and weight in the most compact manner since the expansion of the toggle requires only a small amount of aisle space.

Besides this, the coil lifter may be operated so rapidly and so easily that unloading of incoming material is greatly facilitated. In addition, the coil lifter has simplified the problem of removing coils from the banks and delivering them to each of the blanking presses lining the edge of the storage bay.

The other new development is a compact and automatic machine for producing headlamp rings. This technique is more than just automation for a given operation; it embraces an important cost saving principle that may be employed for other kinds of parts.

The basic principle lies in the fabrication of the odd-shaped cylindrical formation from a minimum sized flat blank instead of the more usual method of deep drawing from a large circular blank.

The Delta machine designed for this purpose is

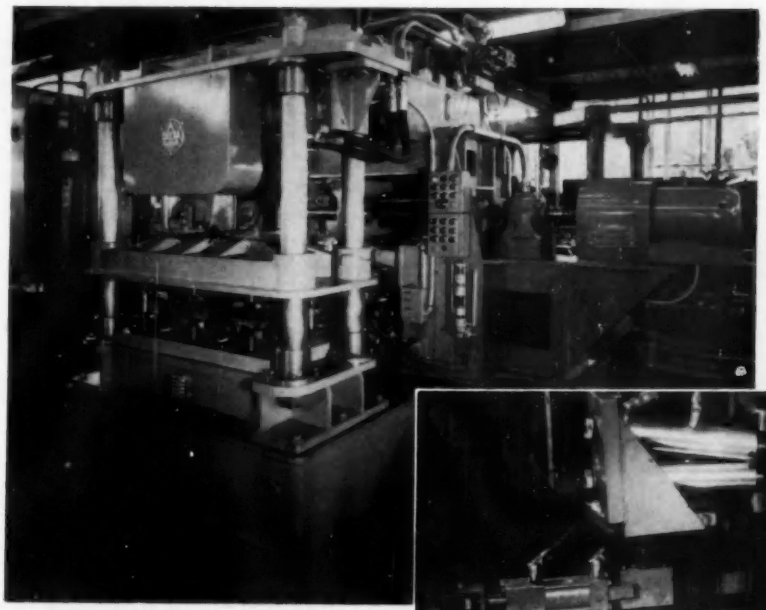
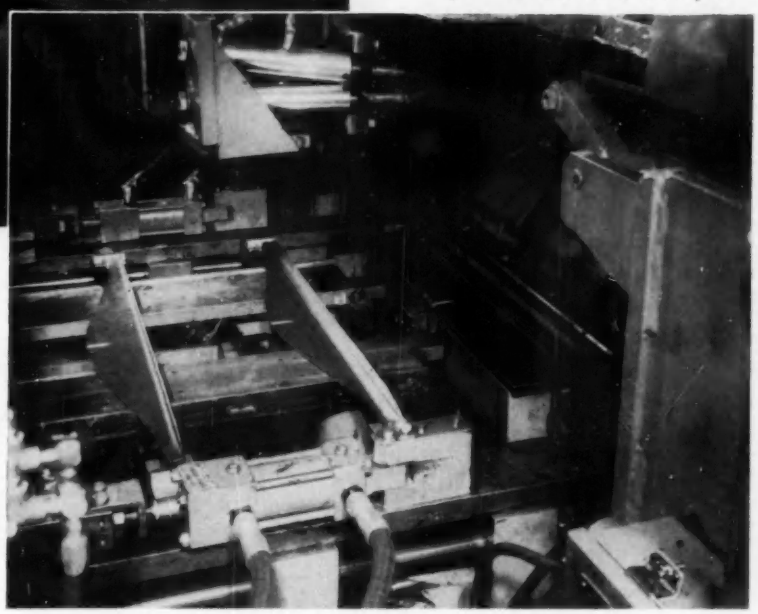


FIG. 2

Front elevation of the Delta automatic machine for forming flat blanks into the cylindrically-shaped headlamp ring

FIG. 3

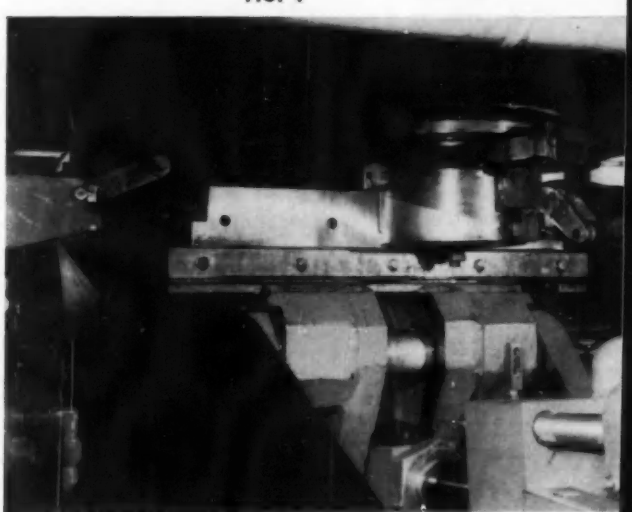
Looking into the Delta machine; this view shows the embossed and flanged blank moving to the rolling fixture on a transfer conveyor.



shown in Fig. 2. Principal steps in the operation are shown in Fig. 2A. Flat formed blanks, such as the one at the left, are fed into the machine at one end as seen in Fig. 3. At the first station the blank is embossed and flanged as shown, then moves into the next station (Fig. 4) where it is picked up on the drum in the foreground. The drum then rotates through 360-deg forming the strip into a cylinder. At the end of this cycle the two edges of the blank are spot-welded to form a completely closed part.

Final operation is to move the rolled blank into an adjacent inclined press where the flange is scalloped and punched for the necessary fastening holes in a single operation. It will be obvious to engineers and die designers familiar with press shop management that any alternative conventional method would involve not only additional press operations but would be extremely wasteful of sheet metal since it would be necessary to start with a large circular blank, producing around 75 per cent scrap eventually.

FIG. 4

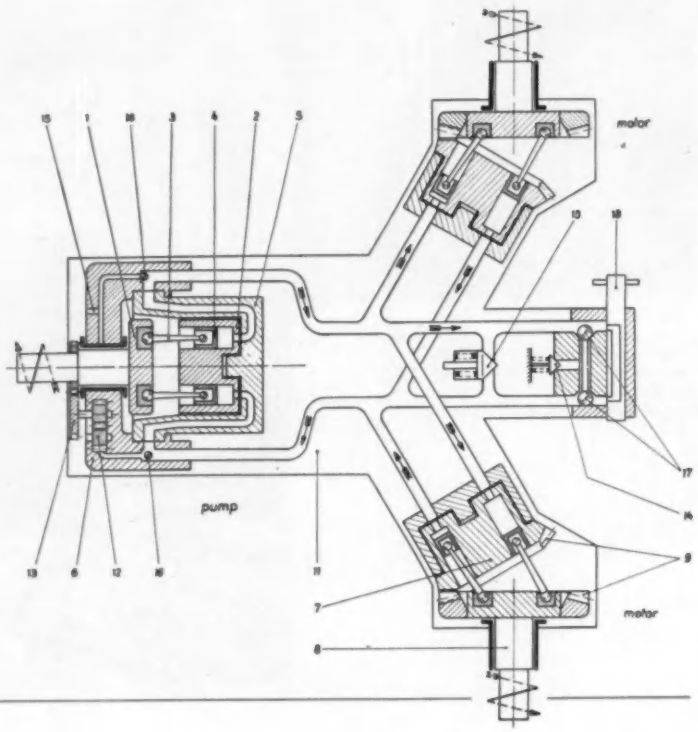


View inside the Delta machine showing the drum which rolls the blank into cylindrical form

German Industrial Truck Has Hydrostatic Drive

OIL FLOW DIAGRAM OF GÜLDNER HYDRAULIC TRANSMISSION

1. Driving flange on input shaft.
2. Cylinder block
3. Connecting rods
4. Pistons
5. Pump housing
6. Pump mounting flange
7. Motor cylinder block
8. Driven flange and stub axle
9. Bevel gears
10. Isolation valve
11. Tubular chassis member
12. Gear pump
13. Drive to gear pump
14. High-pressure bleed valve
15. Safety valve
16. Forward-reverse ball valves
17. Linked ball valves to isolate 14 from main oil flow
18. Cross-over valve to permit pushing the vehicle (shown open)



A TWO-TON industrial truck has been developed by Güldner-Motoren-Werke, Aschaffenburg, Germany, featuring an infinitely-variable hydraulic transmission driven from a single-cylinder Diesel engine. The "Hydrocar" has a tubular backbone chassis in Y-form with the engine and axial-piston pump carried on the front end and individual hydraulic motors on the two forked members which form the rear axle.

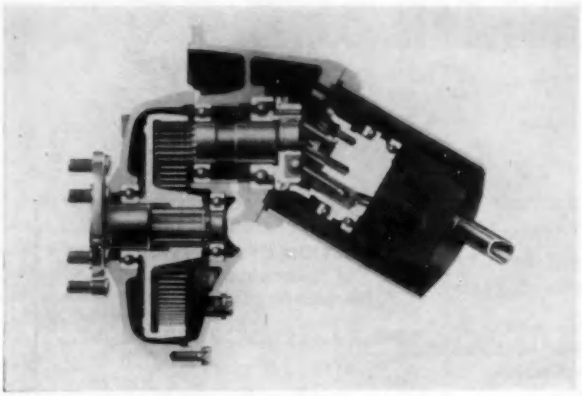
Assuming constant engine speed, pump output (and therefore transmission ratio and vehicle speed) is determined by the angle of tilt of the circular pump body. This has radially-disposed cylinder bores with pistons linked to the driving flange by ball-jointed rods.

Pump body and flange rotate together, and when their two faces are parallel there is no axial piston movement and therefore no output. Piston displacement starts when the pump body is swivelled, and the rate of oil flow is proportionate to the angle of tilt.

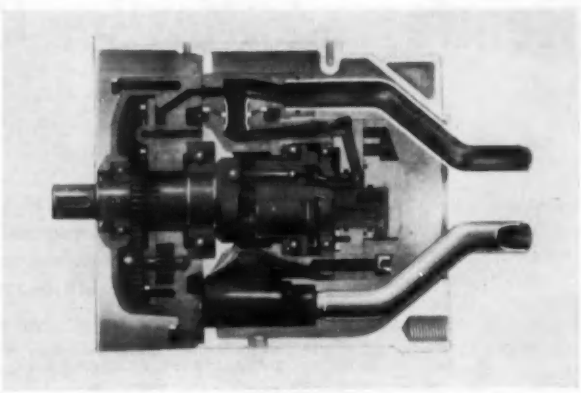
Pipes housed inside the tubular chassis comprise the outward and return circuits to the two motors, which are connected in parallel and are self-compensating for differential functioning. Motors are constructed similarly to the pump, although the cylinder block and driven flange are rigidly positioned at an angle of 30 deg and mechanically coupled by bevel gears. The piston flange is on a shaft terminating in the pinion of the final drive reduction gearing.

To dissipate frictional heat generated by the moving fluid, the entire hollow chassis serves also as an oil storage tank for cooling. Capacity is nine gallons, and a bar magnet is inserted in the oil through the casing to attract metal particles that would otherwise accelerate wear of precision moving parts. This is intended to be withdrawn and cleaned at frequent intervals.

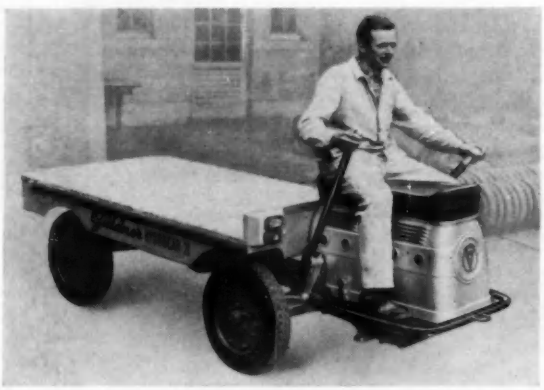
A submerged gear pump, driven from the input shaft of the piston pump, constantly draws in oil from this reserve and forces it under high pressure through a ball valve into the intake side of the piston pump



Individual piston pumps on each drive wheel are permanently angled at 30 deg. Their casing is bolted to the reduction gear housing to form a rigid chassis member.



The main pump is of the axial-piston type, driven directly from the 6-hp Diesel engine. Oil delivery is determined by the tilt angle of the cylinder block in relation to the input flange. The gear priming pump is at the lower left.



A single lever on the Güldner Hydrocar controls forward and reverse movement as well as braking, and incorporates a twist grip throttle. The second main lever is for steering.

and thence it is forced to the transmission circuit.

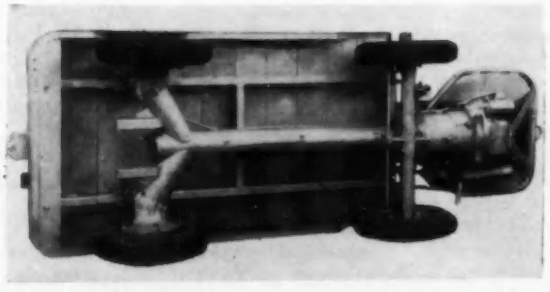
At the same time, surplus oil is bled back to the tank through a spring-loaded release valve in a branch pipe loop shunted across the main circuit between the two motors. A small built-in safety valve protects the main pump against high-pressure overloads.

Motors are reversed by tilting the pump body in the opposite direction to normal, causing a reversal of the oil flow. To enable the gear pump automatically to deliver into the input or low-pressure side of the main pump there are two feed galleries with ball valves that switch this flow according to the back pressure of the circulating oil.

Since the operation is hydrostatic, braking is effected by placing the pump body in the neutral position, when oil delivery stops and the motors are blocked. When stationary the vehicle cannot normally be pushed, since the wheel motors would then act as pumps working against each other. In order to relieve this counter-acting pressure when desired, there is a hand valve in the branch loop which is opened to unblock the input and output pipes temporarily and permit free rotation of the motors.

Motion is regulated by a single lever linked to the pump tilt mechanism, which controls speed in both directions as well as braking. A twist grip operates the engine throttle. The front beam axle is centrally pivoted on the tubular spine as in a tractor, and steering is controlled by a second hand-lever. There is a mechanical parking hand-brake working on the front wheels. The driver sits astride the engine cover on a saddle which is long enough to enable him to face either way.

The aircooled 4-stroke Diesel with 27 cu in. displacement has 2.96 in. bore and 3.94 in. stroke, with 19 to 1 compression ratio and direct injection. Output is 6 hp at 2200 rpm. Unladen weight of the Hydrocar is 2000 lb, overall length 126 in. and width 49 in. The 47-in. by 87-in. platform is suspended on four coil springs. Maximum speed is 9 mph in either direction.



Chassis of the Hydrocar is a Y-form tubular member that serves also as a nine-gallon cooling tank for hydraulic fluid.

Reinforced Plastics Division of the SPI

By Kenneth Rose

A LARGE increase in the use of reinforced plastics was announced during the 12th Annual Conference and Exhibit of the Reinforced Plastics Division of the Society of the Plastics Industry, held in Chicago Feb. 5-7. Close to 140 million lb of the material were consumed during 1956, a gain of 30 per cent over the previous year. It was said that all major automobile manufacturers reported increased use, while aircraft used 20 per cent of the total amount.

Papers devoted to plastics for tooling, truck bodies, and aircraft were features of the Conference. Some of these papers of interest to the automotive field are presented here in condensed form.

PRODUCTION OF POLYESTER RESIN ONLY USED IN REINFORCED PLASTICS

1945	3,500,000 lb*
1946	1,500,000 lb
1947	800,000 lb
1948	1,800,000 lb
1949	4,500,000 lb
1950	8,500,000 lb
1951	14,000,000 lb
1952	19,000,000 lb
1953	26,000,000 lb
1954	27,000,000 lb
1955	49,000,000 lb
1956	71,000,000 lb**

* Entirely for military use
** Estimated

Aggregate Reinforcements for Cast Epoxies

By John Delmonte, President, Furane Plastic, Inc.

THE good bonding and low shrinkage of epoxy resins permit their reinforcement with a large variety of coarse aggregates. Through judicious balancing of finely divded fillers with coarse aggregates, economies in the use of these plastics for tools may be obtained. One aircraft manufacturer has been using a number of tools faced with an epoxy gel coat, and backed with sand, gravel, and epoxy resin formulations, with resin content about 9% to 11% by weight.

Coarse aggregate materials that may be used with epoxy resins include the following: 1) Pebble and stone aggregates such as used in concrete. 2) Silicon carbide or aluminum oxide grains and granules. 3) Silicon dioxide lumps or coarse grains. 4) Porous core volcanic aggregates known as "Epocore." 5) Glass or porcelain marbles. 6) Expanded popcorn. 7) Large aggregates of organic or inorganic origin, proferably nonabsorbent. 8) Expanded microballoons. The material listed as No. 4 Epocore is in wide use for large epoxy tools.

A comparison of density and cost per cu ft shows the economics of its use:

	Epocore and Epocast	Sand and gravel fill	Typical cast phenolic	Typical cast epoxy
Wt. per cu ft	50 lb	135 lb	84 lb	90 lb
Cost per cu ft	$8.00	$15.00	$42.00	$90.00

There are lighter weight materials for filling large voids, but they usually have poor handling qualities and afford lower crushing strength. Crushing strength of Epocore-filled epoxies is about 2000 psi.

A construction successfully used is one in which two plies of glass cloth reinforcement are used for the working face of the casting, and the aggregate is used in the backup.

Marketing Possibilities for Reinforced Plastics in Trucks

By Kenneth C. Sanders, The Heil Co.

AT first glance, truck bodies might seem one of the most unlikely applications for reinforced plastics. Nevertheless, their invasion of the truck body field is proceeding steadily. Their use in refrigerated transportation is especially interesting. There is an annual replacement market of $25,000,000 for refrigerated straight trucks, and $50 million a year for refrigerated trailer replacement. The market for noninsulated bodies and trailers must be four to five times as great.

Present problems of refrigerated trucks are unsatisfactory insulation, corrosion, and excessive weight. Moisture condensation reduces efficiency and adds dead weight, requiring excessive amounts of insulation to give protection. Rust and corrosion follow condensation, shortening body life. Moisture accumulation can easily amount to 300 to 500 lb for an average 12-ft body, and the added weight costs the operator, in hidden operating costs for the truck, $300 to $500 per year.

The construction used at Heil Co. molds a sandwich of inner and outer layers of glass-reinforced plastics with a low-density insulating core between, and forms the complete body in one operation. This gives superior insulation with no moisture pickup, reduces weight 10 to 20 per cent over

Holds Annual Exhibit and Conference

the lightest metal construction of the same capacity, and eliminates rust and corrosion. By saving 2 in. to 3 in. on wall thickness, cargo space is increased. Savings for the operator amount to $400-500 per year. Results are based upon operation of several hundreds of plastics tanks for up to three years in every part of the United States.

Tooling costs for plastics truck and tank production are high, and styles must be standardized to take advantage of the material.

Strength-Time Relationships of Silicone Laminates Made from Various Materials

By J. R. Bond and E. C. Elliot
Dow Corning Corp.

To determine the properties of silicone resins with various reinforcing materials, when subjected to temperatures up to 1500 F, for one side and for both sides of the laminate, tests with the following fillers were made: Heat cleaned 11 glass cloth; 9526 NS asbestos; 9524 NS asbestos; 9529 asbestos; 9526-RB-5 asbestos; Refrasil 100-N-C; Fiberfrax 970-AH. Laminates tested were 0.125 in. thick.

The following conclusions were reached: the room temperature and high temperature flexural strengths of laminates containing less than 50 per cent resin are superior to similar properties in those of more than 50 per cent resin content. Laminates made with glass fabric have the best physical properties up to 500 F. Asbestos felt laminates have the best physical properties in the 1000 F range with both one side and complete exposure. Asbestos felt laminates have the best physical properties with one side exposure in the 1500 F range, and 181 glass cloth laminate has the best physical properties with complete exposure at this range. Use of Fiberfrax faces on laminates does not show any advantage at the temperatures tested, although it might be superior at higher temperatures.

Unsteady State Heat Transfer Characteristics at High Temperatures Through Reinforced Plastics

By J. L. Dietz and W. J. Hangen
Materials Laboratory, Chrysler Corp. Missile Operations

AERODYNAMIC heating of the nose cone and air frame of a long range guided missile may cause temperatures of from 500 to 10,000 F. Because of the extremely short service life of the missile and the relatively low thermal conductivity of the material, a thermal equilibrium is not reached in flight, and it has proved possible to extend the surface of the plastic to its degredation point while still obtaining the required performance from the remainder of the material.

For a silicone resin-glass cloth laminate and a silicone resin-glass fiber molding compound, it was found that thermal conductivity increases with increase of temperature; the specific heat increases steadily with temperature rise up to about 550 F, then dips, then increases again to the point of resin breakdown at about 600 F for the glass cloth-silicone. Specific heat increases steadily for the glass fiber molding compound; and thermal diffusivity for the glass cloth-silicone material decreases from about 200 F to 400 F, while the diffusivity curve of the glass fiber-filled molding compound remains relatively flat. These tests show that, as temperature increases, the rate at which heat is transferred through the material decreases, and the short time at high surface heat does not greatly reduce physical properties.

Results for the Teflon resin-glass cloth laminate show that thermal conductivity increases only slightly with increasing temperature, that specific heat increases to about 620 F, then dips slightly, and thermal diffusivity decreases with temperature rise. Here also the strength of the laminate is not greatly decreased by short time heating at the face.

Use of Reinforced Plastics in Military Aircraft

By S. F. Held, Chance Vought-Aircraft, Inc.

REINFORCED plastics, with their high strength-weight ratios combined with usable strength at temperatures to 500 F, are eligible for applications traditionally in the domain of structural metals. At present, they are used extensively in military aircraft in electronic systems, outer panels, ducts, fuel cell covers, scuff pads, wing tips, housings, sheathing, honeycomb structure, and base sheet for electronic circuits. Usable working temperature limits for the available classes of resins are as follows:

Polyester	200 F
Epoxy	250 F
Polyester TAC	400 F
Polyester DAP	400 F
Phenolic	450 F
Silicone	500 F

Advantages of reinforced plastics for military aircraft are: 1) It presents a smooth surface as fabricated, causing less drag. 2) It has excellent dielectric properties. 3) Because of integral shell design, with relatively large parts formed to shape, fasteners and welding can be eliminated. 4) Double curves can be formed with a minimum of equipment. 5) Maintenance is easier. 6) Corrosion resistance is excellent. 7) Thermal conductivity is low. 8) Materials are nonstrategic. Disadvantages are: 1) Control of quality is difficult, due to nonuniformity of materials and processing. 2) Exact technical and design data are insufficient. 3) Control of laminate thickness, except by matched metal dies, is poor. 4) Specific modulus of elasticity is low—2,000,000 to 3,000,000. 5) Structural strength at temperatures above 500 F is low. 6) Resistance to rain erosion is poor.

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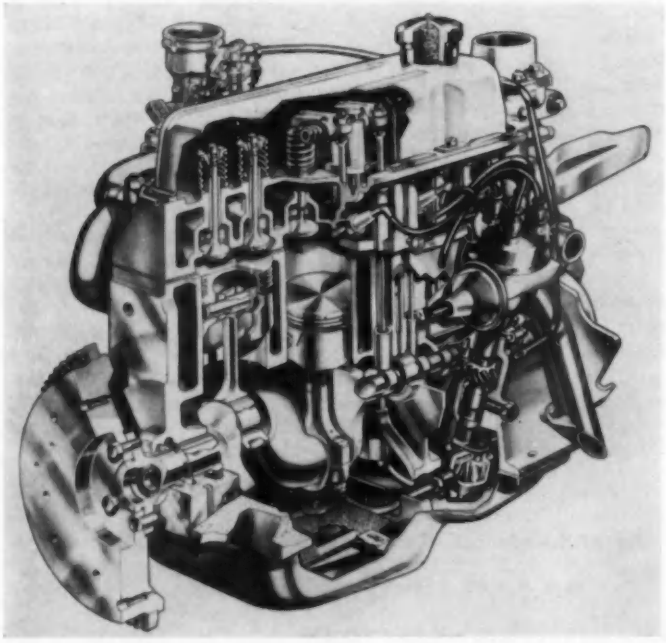
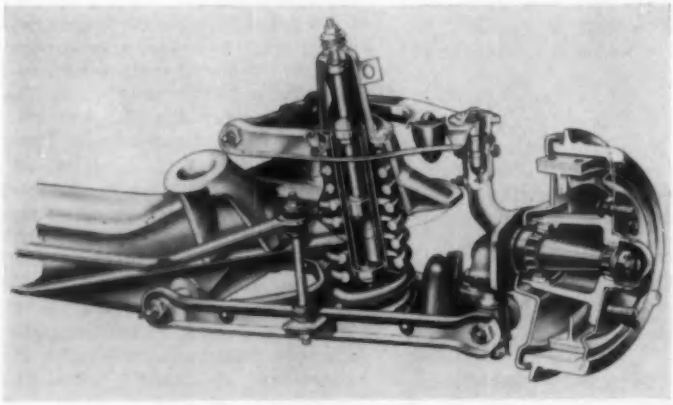
The Vauxhall Victor has both panoramic windshield and wraparound rear window

The New Vauxhall Victor *features* Large Glass Area



Cutaway view of the 92 cu in. engine which develops about 55 hp at 4200 rpm



Front suspension which features long support arms

THE Vauxhall Victor, produced at General Motors' new 1.5 million-sq ft plant at Luton, England, is a medium-sized four-passenger sedan with a large glass area provided by the first wrap-around windshield on a European car. The four-cylinder engine with a 92 cu in. displacement is rated at 54.8 hp at 4200 rpm and develops a maximum torque of 84.5 lb ft at 2400 rpm.

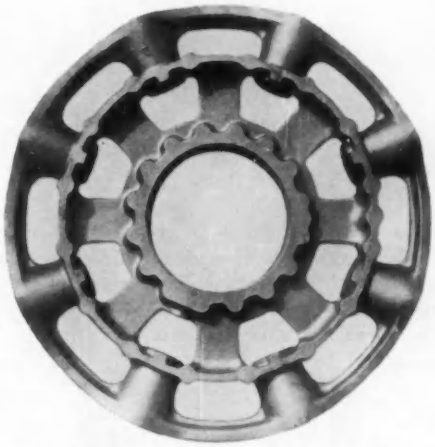
Of over-square design, it has 3⅛-in. bore and 3-in. stroke, with 7.8 to 1 compression ratio. Good breathing and volumetric efficiency are claimed to result from the use of individual inlet valve ports instead of the usual Siamesed type, and of 1.437-in. diameter inlet valves.

Added stiffness is given by extending the skirt of the cylinder block casting to well below the crankshaft center line. Pistons are offset 1/16 in. towards the thrust side for quieter running. The three-speed gearbox with steering column shift has synchromesh on all forward ratios.

Front suspension with coil springs encircling piston-type shock-absorbers features exceptionally long support arms to improve tire adhesion during deflection and permit large rebound movement. The steering knuckle is linked by a ball joint at the top and trunnion mounting at the bottom.

The underside of the integral body-chassis is coated with a 1/16-in. layer of plastic material baked on to sound-deaden and rust-proof the panels. Curb weight of the Victor is 2150 lb, wheelbase 98 in., overall length 166½ in., width 62⅛ in., and height 58 in.

Jet Engine Parts Cast in Shell Molds



Shell molded jet engine support ring

THE shell molding process is being used successfully at Cooper Alloy Corp. of Hillside, N. J., to produce jet engine support rings for Pratt & Whitney Aircraft after several other methods failed to meet requirements. These methods were green sand, dry sand, core mold, and investment methods.

Sand casting could not measure up to the rigid standards of accuracy required or produce the correct surface finish. Core molding could guarantee the soundness but could not approach the accuracy of surface finish standards; and the size of the part put it just beyond wax investment methods. Here are the specifications which had to be met:

1. Material: high chrome-nickel alloy, held within the following composition range:

Carbon	0.15%- 0.25%
Chromium	17.00%-20.00%
Nickel	12.00%-15.00%
Silicon	1.00% max.
Manganese	2.00% max.
Sulphur	0.03% max.
Phosphorus	0.04% max.
Molybdenum	1.75%- 2.50%

2. Dimensions: 14¾ in. in diam, 2½ in. high, weight 35 lb.
3. Surface Finish—Approximately 150 rms.
4. Freedom from Defects—100% perfect under X-ray examination. 100% perfect under zyglo. Castings had to be heated to 200° F before immersion in oil penetrant.

Since a number of other methods had been tried and proved unsuccessful, it was decided to make the rings by the shell molding process. Although difficult because of the weight of the part (35 lb) and the high standards of accuracy needed, this was possible through the maintenance of close controls.

Before the patterns were made, however, two design modifications consistent with sound casting principles were incorporated. The first was to cast the outer bore openings solid; the second was to alter casting dimensions to permit gradual blending from light to heavy sections of the part in order to avoid hot tearing.

With the design set, experimental patterns were made and pretested. Pour-off tests were conducted and the resin-sand mix was modified with special fillers made of zircon flour blended with AFS 150 grain fineness sand to assure the best possible surface finish.

After extensive experimentation had resulted in a satisfactory pattern and mold mix, the following procedures were established: maintain pouring temperatures within a range of ± 25 F; preheat cope and drag patterns to identical temperatures before the shells were molded; place shell molds, while still warm, in special presses to prevent warpage; carefully glue the shell mold halves; bed the mold in backing sand to

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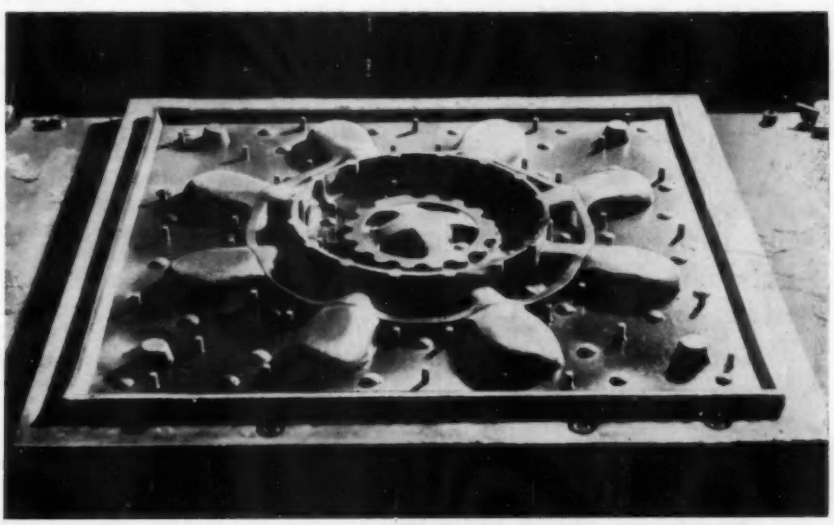

Precision machined steel pattern designed specifically for shell mold production

New Developments in

BASED on actual usage in the aircraft industry, turbine bearings are classified into three general groups of sizes. The product of bearing bore in mm (D) and shaft speed in rpm (N) is used as a comparative operating characteristic.

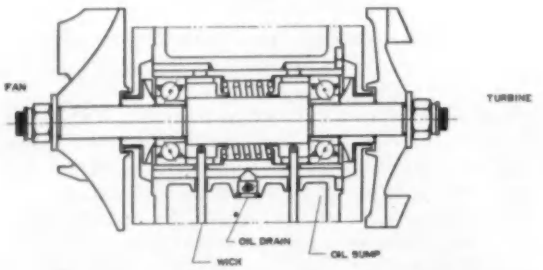

Fig. 1—Typical refrigeration turbine installation

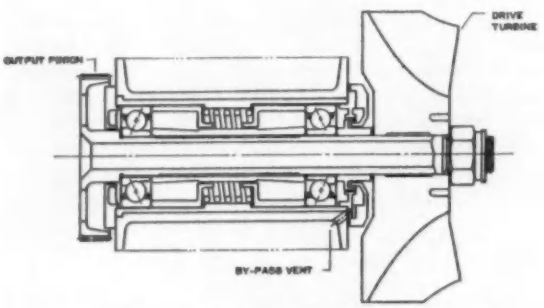

Fig. 2—Typical bearing mounting for alternator drive power turbine

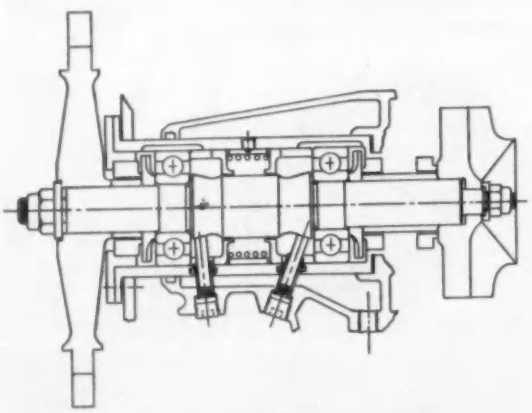

Fig. 3—Bearing mounting for fuel pump turbine

(a) 8 mm-20 mm Bore Bearings: 25,-000-130,000 rpm
Auxiliary air and gas turbines
Maximum DN = 1.3×10^6
Maximum temperature 450 F.
Lightly loaded

(b) 25 mm-60 mm Bore Bearings: 18,-000-45,000 rpm
Medium size gas turbines
Maximum DN = 1.2×10^6
Maximum temperature = 400 F.
Medium loading

(c) 110 mm-220 mm Bore Bearings: 7,-000-10,000 rpm
Turbo jet and turbo propeller engines
Maximum DN = 1.5×10^6
Maximum operating temperature = 400 F.
Heavy loading

With flight speeds of some present day fighter planes at Mach 2 and planes in the development stage to fly at speeds approaching and exceeding Mach 3, it will be necessary to furnish bearings capable of operating at temperatures of 500-700 F with the ultimate goal of 1000 F operation. Speeds equivalent to DN values of 2×10^6 at fairly high thrust loading are to be expected.

To research programs at New Departure are now in progress to develop bearings to meet the above condition of operation, one concentrating on bearings in group (a) and the other on bearings in group (3). Although DN value and temperature goals are identical, the design philosophy for the two groups of bearings is vastly different and necessitates an individual research approach to both.

In order to show how the various types of high speed bearings are used, and what is necessary for their successful operation from a mounting and lubrication standpoint, a series of application drawings have been compiled representing a cross-section of the gas turbine engine and turbo accessory field.

The typical refrigeration turbine installation shown in Fig. 1 employs bearings in the 8 mm to 15 mm bore sizes which are required to operate at 75,000 to 120,000 rpm under conditions of scant and often inadequate lubrication. The rotative assembly is exposed to reversing and varying thrust loads as well as rotating radial loads, due to unbalance.

In view of the speed requirements, ultra high speed bearings with one-piece outer ring riding in pressed metal cages are employed, although very successful operation is presently being achieved in production units using deep groove type bearings with inner ring riding in cages up to the 1,000,000 DN range.

Bearings for Aircraft

By Heinz Hanau
Supervisor, Aircraft Projects
NEW DEPARTURE DIV., GMC

Weight and bulk limitations in these aircraft refrigeration turbines prevents the use of oil pumps and the present state of the art does not permit successful grease lubrication. It therefore becomes necessary to resort to the recirculating oil type of wick lubrication shown.

The wick feeds oil from the sump and unloads it at the contact point with the high speed shaft, where it is thrown off into the space in front of the bearing. Suction slingers behind the bearings create a circulating air current which forces the oil mist through the bearing. Some of the oil is thrown out of the air stream and returned to the sump through the return passages, but most of it is re-circulated through the bearings through the by-pass slots in the housing. In effect, two independent oil lubrication systems are shown; one for each bearing. This helps to prevent lubrication starving of either bearing.

The type of bearing employed permits the use of cages having "minimum restriction to airflow."

The bearing mounting is of the reversible type. designed to support thrust in either direction and by either bearing.

When the external thrust load exceeds the preload spring force, the rotating assembly moves axially until the spacer seats against the thrust shoulder in the housing. A preload thrust will continue to be applied against the unloaded bearing, a very necessary feature in a high speed bearing.

This type of mounting avoids the highly undesirable condition of contact angle reversal during thrust reversal. As the thrust reverses, the bearing contact angles stay in the same relative position of angularity, and the whole rotative assembly moves over against the opposite housing shoulder without the spring preload on the bearings ever being relieved.

Several sizes of bearings are operating satisfactorily in these types of units at DN values in excess of 1.1 x 10^6 with operating temperatures up to 400 F. The major difficulties encountered are those of providing adequate lubrication to both bearings at all times, particularly under varying conditions of altitude and temperature, as well as the problem of adequate shaft balance, since only the slightest overspeed condition can cause stretching of parts with resultant destruction of the balance originally built into the unit.

Dynamic balancing of the rotating assembly in such a unit should be done to better than 0.0005 inch-ounces.

The problem which is considered indirectly a bearing problem is that of assuring that the limited quantity of oil contained in these units will not be lost through the seals before overhaul time is reached.

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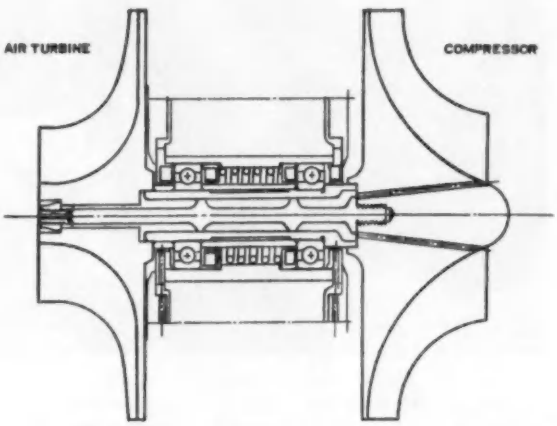


Fig. 4—Bearing mounting for turbo compressor

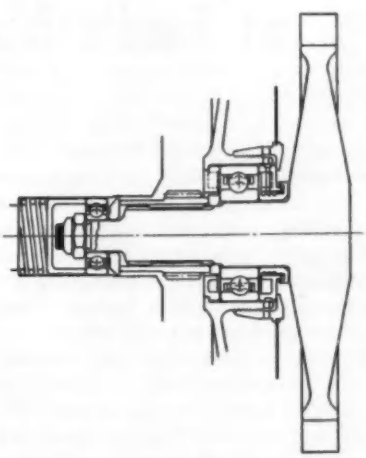


Fig. 5—Bearing mounting for jet engine starter drive

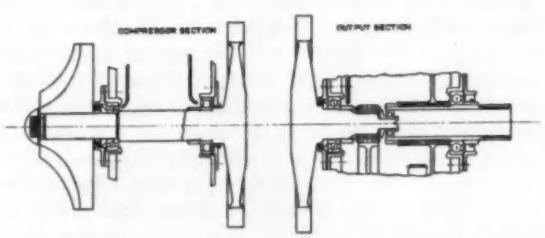
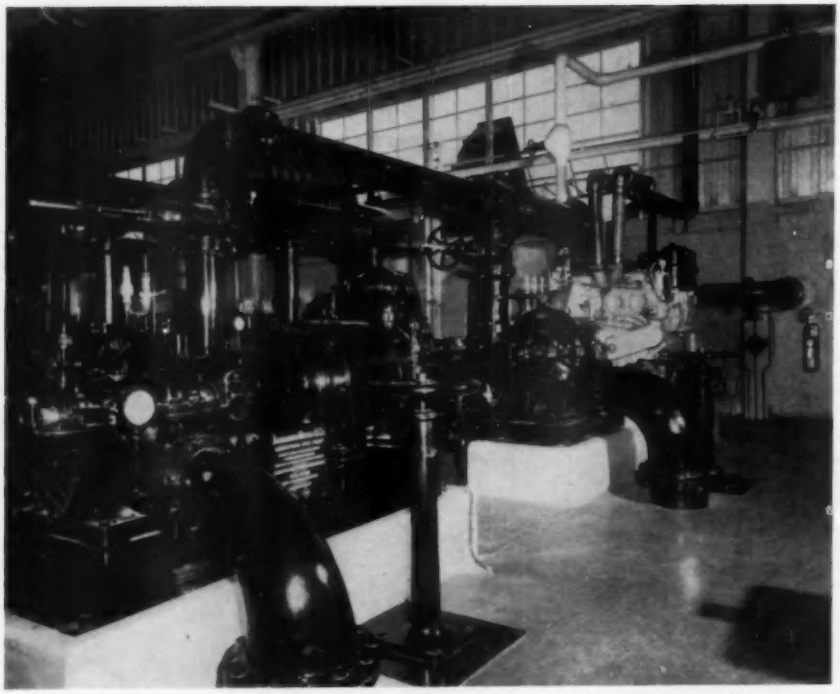


Fig. 6—Bearing mounting for small gas turbine engine



Shown in the right background is the large Fairbanks-Morse Diesel-driven fire pump. This 2500 gpm unit, and the 1500 gpm motor-driven pump in the foreground, form the backbone of the fire system at the plant.

Complete Fire Protection Setup at Ford's Mahwah Assembly Plant

THE Ford assembly plant at Mahwah, N. J., has one of the most elaborate fire-fighting systems in the industry. One measure of the magnitude of the fire protection problem is the size of the plant itself. The shop and assembly area is 2115 ft long and 792 ft wide, providing more than 1½ million sq ft of manufacturing space. Here engines, bodies, frames, wheels and all other component parts of cars and trucks are brought together and assembled on a network of conveyors which total more than 11 miles in length. In addition, there is a two-story administration building in front of and adjoining the assembly plant. This structure, housing all offices and employee facilities, adds another 17,455 sq ft.

Multiple sources of water afford the basic protection and at the heart of the system are two Fairbanks-Morse fire pumps, one back-stopping the other. Water for both the fire system and the normal plant water supply comes from the wells of the Mahwah township system through a 16-in. main at 40 to 55 psi. At a metering station on plant grounds, the main divides into a 12-in. line for the normal plant supply and an 8-in. line for the fire protection system. To provide instantly the large volume of water that might be needed to combat a major fire, township water is stored in two cylindrical steel ground storage tanks, each with a capacity of 250,000 gal. Check valves on the inlet lines prevent blackflow and the stored water can get out only through the fire pumps.

A 14-in. line from each tank joins in a 16-in. line to the boiler house where the fire pumps are installed. The pumps chosen for this service are two Figure 5814F Fairbanks-Morse horizontal centrifugals. One is a 6-in. pump with rated capacity of 1500 gpm at a discharge pressure of 125 psi. This is driven directly by a 150-hp Fairbanks-Morse Type QZK induction motor at 1770 rpm. The second pump is even larger, an 8-in. F-M unit rated at 2500 gpm and driven through power transfer gears by a pair of six-cylinder Diesel engines. Actually there are three pumps, the third being a 1-in. Fig. 5592 F-M centrifugal driven at 3475 rpm by a 15-hp motor.

The fire pumps discharge to a 12-in. line feeding a 12-in. underground fire loop that runs completely around the main plant building, a total of nearly 7000 ft. From this loop, branch lines run to vertical 8-in. risers inside the East and West walls of the plant. There are 58 risers, each supplying more than 300 sprinkler heads—a total of more than 17,000 sprinklers protecting the manufacturing and assembly areas.

Water is maintained in all the lines at 125-lb pres-

(*Turn to page* 55, *please*)

What is the Best Tire Cord for Safety and Value?

COMPARATIVE TIRE COST PER 100 MILES

	Nylon	Rayon
New Tire Cost	$23.21	$19.53
Cost/Retread	$7.00	$7.00
No. Tires in Test	27	28
Total No. Retreads Obtained	116	58
Total Tire Cost	$1,438.67	$952.84
Total Tire Miles	2,012,150	1,163,103
Cost/100 Miles	$0.071	$0.082

CAUSE OF TIRE FAILURES

NYLON

	Original Tread	Retreads 1st	2nd	3rd	4th	5th	Total
Fiber Failure							
Impact Breaks	—	—	—	—	—	2	2
Flex Breaks	—	—	—	—	—	—	0
Ply Separation	—	—	—	—	—	—	0
Cut	—	1	—	—	—	1	2
Human Error							
Repair Failure	—	1	1	—	—	—	2
Run Worn Out	1	—	1	—	—	—	2
TOTAL	1	2	2	0	0	3	8

RAYON

	Original Tread	Retreads 1st	2nd	3rd	4th	5th	Total
Fiber Failures							
Impact Breaks	1	5	6	1	2	1	16
Flex Breaks	—	—	—	1	—	1	2
Ply Separation	—	1	2	—	—	—	3
Cut	3	—	—	—	—	—	3
Human Error							
Repair Failure	—	—	1	2	1	—	4
Run Worn Out	—	—	—	—	—	—	0
TOTAL	4	6	9	4	3	2	28

TIRE FAILURES VS RETREADS

NYLON

	Original Tread	Retreads 1st	2nd	3rd	4th	5th	Total
No. Tires	27	26	24	22	22	22	—
Failures—All Causes	1	2	2	0	0	3	8
Fiber Failures	0	0	0	0	0	2	2
Tires Running	—	—	—	—	—	—	19

RAYON

	Original Tread	Retreads 1st	2nd	3rd	4th	5th	Total
No. Tires	28	24	18	9	5	2	—
Failures—All Causes	4	5	9	4	3	2	28
Fiber Failures	1	5	6	2	2	2	18
Tires Running	—	—	—	—	—	—	0

OVER the years, various cords have been developed that have greatly improved the safety and service life of tires. In recent years rayon improved on cotton; high tenacity rayon on rayon; and now, the battle is on between nylon and rayon.

At present, essentially all premium passenger tires are constructed with nylon tire cord. Nylon also is used in all aviation and large off-the-highway truck tires. In the latter applications, nylon has more than proved its capabilities. Now, over-the-road fleet operators and passenger car users have shown much interest in the economic advantages of nylon over rayon.

After almost two years' testing in taxicab fleet service, the Textile Fibers Department of du Pont, Wilmington, Del., has completed an important stage of its field research program on nylon and rayon tire cords. Since the company produces both rayon and nylon, it was completely impartial as to the results of the testing program. The main interest was to determine the best tire cord per unit of value, both for safety and mileage.

Beginning in 1955, the program was set up with a taxicab fleet to compare regular size 6.70-15, four-ply, black sidewall, tube type rayon versus nylon passenger tires from a major tire manufacturer. A Wilmington fleet was chosen since it represented a means of closely following the performance differences of tires in a relatively high mileage operation.

The test originated with 34 nylon and 34 rayon tires mounted on 17 taxicabs with each cab equipped with two nylon and two rayon tires. During the test period, a total of seven nylon and six rayon tires were removed at intervals for purposes of laboratory analysis. Complete performance data were obtained on the 27 nylon and 28 rayon tires that remained in service.

Upon completion of the tests, du Pont engineers made the following observations:

—After 21 months' service, the average nylon tire life was original tread plus 4.3 retreads. With 70 per cent of the nylon tires still in service, it is probable that the final average tire life will be in excess of five retreads.

—All rayon tires had failed within the 21-month interval with an average tire life of original tread plus 2.1 retreads.

—The cost per 100 miles for each nylon tire was $0.071 versus a final rayon tire cost per 100 miles of $0.082. With the 70 per cent nylon tires still in service, it can be expected that the cost per mile will be further reduced.

—Nylon tires accumulated 73 per cent more miles than the rayon tires.

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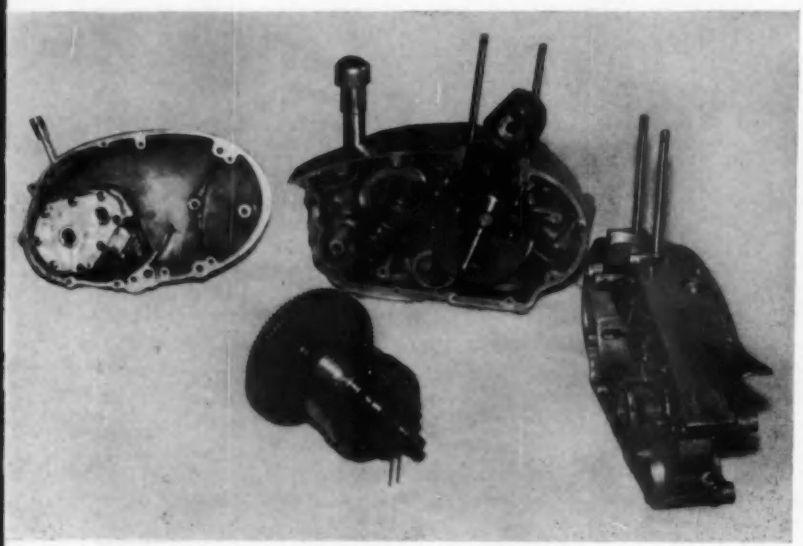


Dismantled MV Agusta 172 cc motorcycle engine with the Badalini transmission. The hydraulic unit occupies the space of the usual gears, and the variable-tilt swash plate can be seen in the central casting just behind the crankshaft. The left-hand housing contains the oil priming pump.

By
David Scott

NEW HYDRAULIC TRANSMISSION

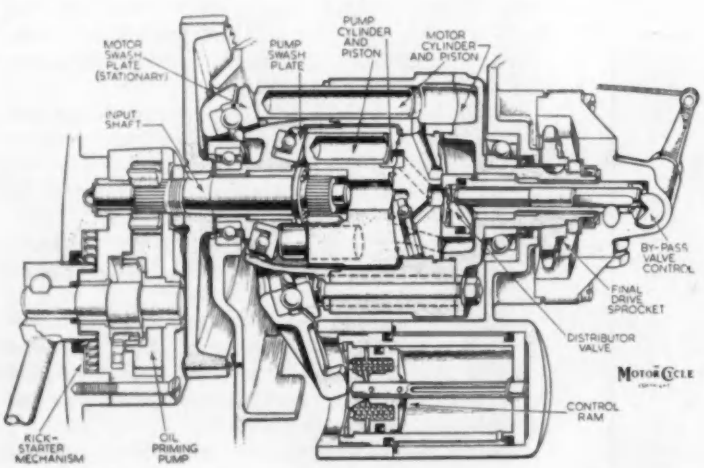
A NEW infinitely-variable hydraulic transmission, developed by Cambi Idraulici Badalini S.p.A. of Rome, Italy, is stated to have wide automotive applications and to lend itself to fully-automatic control. High efficiency is claimed to result from the combination of hydraulic and mechanical coupling. At the bottom ratio of 3.5 to 1 this is understood to be 86 per cent, rising to 96-98 per cent at 1 to 1.

Units have been built in a range from 150 hp for industrial equipment down to a few horsepower for motorcycles. In the latter case, production cost, weight and size are reported to be about the same as a conventional four-speed gearbox and clutch.

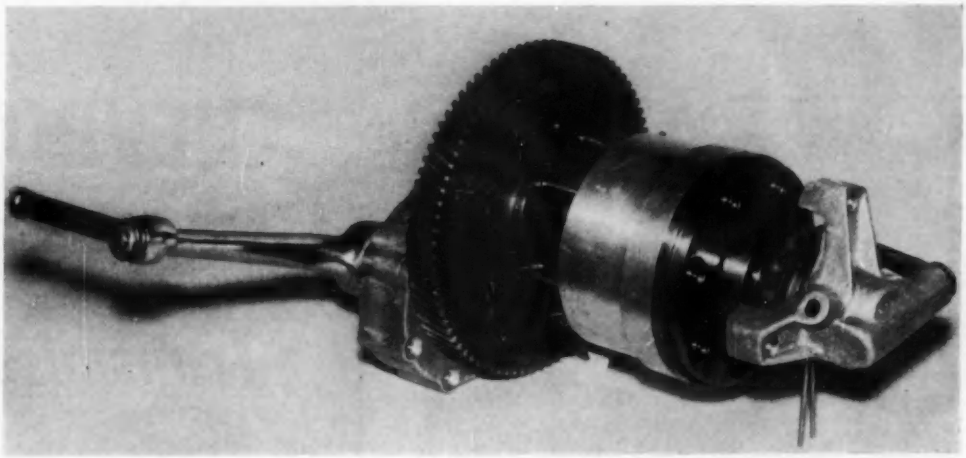
The transmission consists of a swash-plate pump encircled by a motor of similar design, each having seven pistons. The pump is driven by the input shaft at half engine speed, and delivery is regulated by a fixed-angle swash plate attached within the motor body and rotating with it. Oil is channeled from the pump through galleries and a distributor valve to the cylinders of the hydraulic motor.

Output of the motor is controlled by a tilting swash plate mounted externally on trunnions. Its facing ring against which the pistons bear is carried in a ball race. Inclination of the ring is varied by the driver through a hydraulic cylinder. A gear pump on the input shaft supplies engine oil under pressure to this ram, and keeps the entire hydraulic system primed through a ball valve.

To disengage the drive completely there is a taper-seat valve which serves as a clutch. This causes fluid to bypass the motor and recirculate within the free-running pump.



Sectioned view of the infinitely-variable transmission. Pump and motor are mounted coaxially on individual splined shafts, and ball thrust races form the swash plates. Courtesy The Motor Cycle —London.



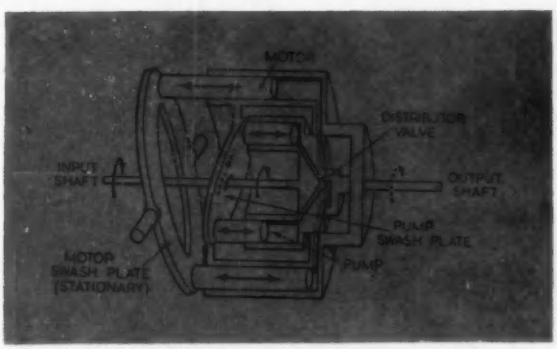
The Badalini transmission for a motorcycle, showing the kick starter and input reduction gear on the left, and the release mechanism for the bypass valve and output sprocket at the extreme right.

Features Exceptional Efficiency and Infinitely-Variable Ratios

For power transmission the lowest ratio is obtained when the motor swash plate is inclined at the maximum angle. Pistons are then reciprocated at their full stroke, and the speed of motor rotation is in inverse proportion to oil displacement. Correct balance of fluid volume is maintained, since the pump swash plate revolves with the motor.

The ratio decreases with the tilt angle of the motor swash plate, and 1 to 1 is reached with the plate is at right angles to its axis. There is then no cam action and no piston movement, and the motor is hydraulically locked to the pump and rotates with it as a unit —thus accounting for the high efficiency. The degree of effective mechanical coupling drops at the lower ratios, but this factor minimizes hydraulic losses through the full range.

The Badalini transmission provides effective engine braking, and reverse can be obtained without auxiliary gearing either by tilting the motor swash plate in the other direction, or by varying the radial position of the oil distribution valve. It is understood that automatic control regulated by engine speed is carried out by actuating the control ram with oil supplied from the priming pump on the input shaft.



Simplified diagram showing basic operation principle of Badalini transmission. Courtesy The Motor Cycle—London

• • •

. . . Details of the CHEVROLET *Turboglide* Transmission

By F. J. Winchell,
W. D. Route, and O. K. Kelley
GENERAL MOTORS CORP.

THE Chevrolet Turboglide is a non-shifting, concurrent-geared, multiple turbine transmission with dual stator blade control. It has no low gear and is unique also in that the transmission performance ratio is available at any throttle position. This means that torque ratio and engine output can be modulated simultaneously simply by depressing the throttle pedal.

There are no up-shifted performance "holes" in city or hill climbing operation. Maximum engine and normal transmission performance converge smoothly at wide open throttle. Further depression of the throttle pedal through a conventional detent changes the stator blade from the normal or cruise angle to the performance or passing angle.

The Turboglide incorporates a five-element torque converter—a pump, three turbines, and the dual stator. The torque converter operates in conjunction with two simple planetary gearsets. The three turbines are concurrently connected to the driveline at ratios of 2.67 for the first, 1.6 for the second, and 1 for the third. The first and second turbine reactions are grounded through one-way clutches to permit inactivation at the limit of their useful speed range.

Since an independent low range is not required, a Grade Retarder range is provided by gearing the first turbine at the 2.67 ratio in the conventional manner, while permitting the second and third turbines to run free.

Reverse is accomplished by compounding the two planetary gearsets.

Drive, Grade Retarder, Reverse, and Neutral require the use of three cone clutches, one plate clutch, and two one-way clutches. Park augments Neutral with a pawl and gear type lock on the output shaft.

The shift quadrant sequence is P, R, N, D, and GR.

Cruise angle stall torque ratio is 3.8 to 1, at an engine speed of 1700 rpm. This is with the Chevrolet 283 cu-in., 4-barrel carburetor engine. Wide open throttle coupling occurs at about 50 mph and 2700 engine rpm. Performance angle stall torque ratio is 4.2 to 1 at 2600 engine rpm. Wide open throttle coupling at this ratio occurs at about 65 mph and 3200 engine rpm.

Part throttle starts in cruise angle are "tight" and connected as a result of the low stall speed and high torque ratio. Actuation of the detent permits the blade change and resulting higher engine speeds for maximum horsepower.

The structural components as well as many functional elements are of die cast aluminum. The elimination of radial and bending loads through use of clutches instead of bands permits a compact and rigid design with relatively light construction. The absence of "power shifts" eliminates the requirement for calibration and timing functions, thus greatly simplifying the control system. Total installed weight of the transmission is 148 lb.

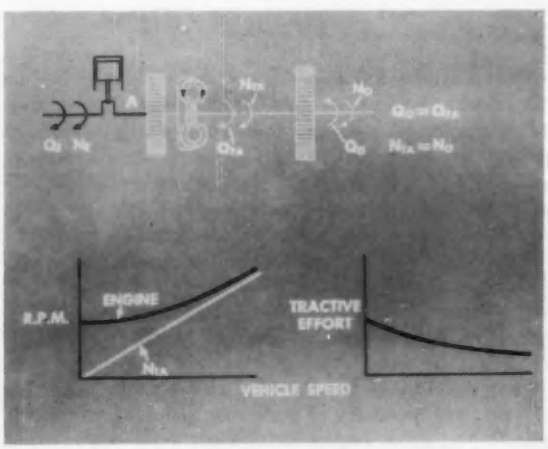


Fig. 1—One transmission

Operating Principle

Concurrent gearing is best illustrated, perhaps, by combining three transmissions in parallel as follows:

Fig. 1 shows a single three-element converter direct drive transmission (A) and its characteristic performance curves. This transmission is deficient for both starting and passing, is adequate for cruise only.

If it is combined with a second transmission, B (see Fig. 2), with the turbine geared through the output shaft at a ratio R_b through a one-way clutch, the total load on the engine is the sum of the driving torques

of both converters. Thus, with the addition of transmission B, the input speed is reduced at stall. As the output load is relieved and acceleration begins, the speed of turbine B increases at the rate R_b times the output shaft rpm. As the turbine B approaches the speed of the engine, the torque required to drive pump B approaches zero. Thus, at and above point X (see Fig. 2), pump A alone is controlling engine speed. From this point, turbine B no longer is driven and it coasts at about engine speed. Turbine B torque is zero, of course, at the freewheel point.

The combined output torque at any point is equal to the output of A plus the ratio R_b times the output of B. The result is a smooth speed and tractive effort curve uninterrupted by abrupt ratio changes. This combination is adequate for passing and cruising, but is still deficient for starting.

For starting performance, a third transmission operating at a larger reduction (R_c) is added as shown

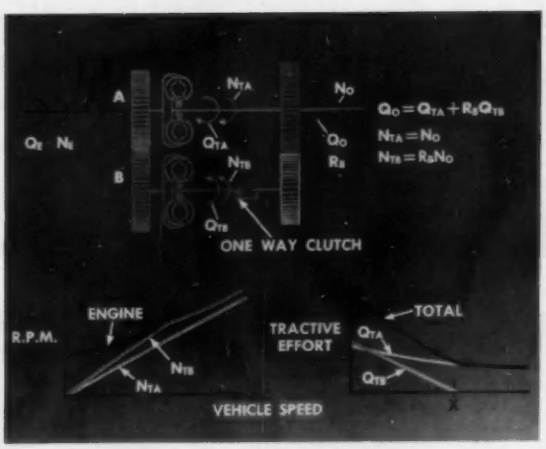


Fig. 2—Two transmissions operating concurrently

in Fig. 3. This results in turbine C becoming inactive and freewheeling at a lower vehicle speed, due to the larger reduction.

Now, the total output at any point is equal to the output of A, plus the ratio B times the output of B, plus the ratio C times the output of C.

Turboglide Arrangement

The Turboglide is a coaxial arrangement of the foregoing principle; it requires, however, only one pump and stator and, of course, no input gearing. For clarity, the arrangement for forward operation is illustrated function by function as follows:

(Note: Turbines are identified according to SAE recommendations so that $T_c = T_1$; $T_b = T_2$; $T_a = T_3$.)

Turbine A (Fig. 4) is connected directly to the output shaft, and provides cruising performance.

The "passing" turbine B (Fig. 5) is geared to the

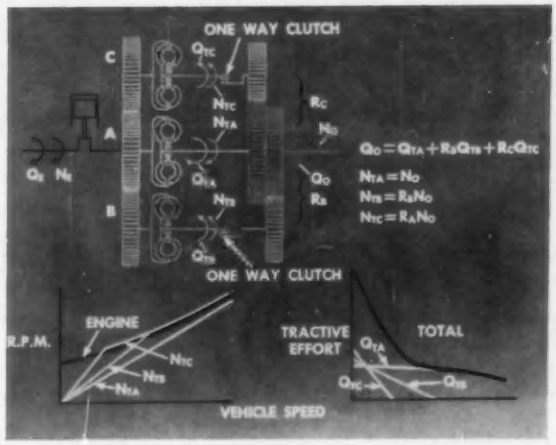


Fig. 3—Three transmissions operating concurrently

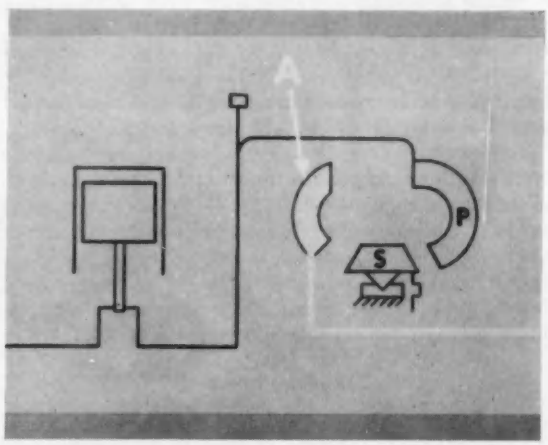


Fig. 4 — Turboglide arrangement (cruising performance)

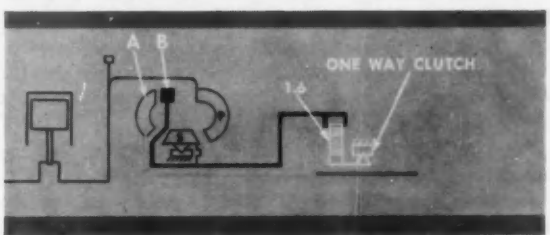
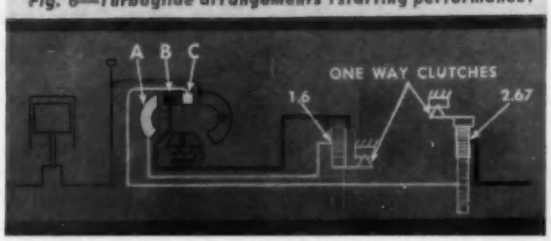


Fig. 5 — Turboglide arrangement (middle or passing ranges)

Fig. 6—Turboglide arrangements (starting performance)



output through a simple planetary gearset at a ratio of 1.6 to 1. The input member is the ring gear; the output is the carrier, which is integral with the T_3 shaft; the reaction is the sun to ground through a one-way clutch. Turbine A drives the output shaft directly.

The turbine C (Fig. 6) is geared to the output through an identical planetary gearset at a ratio of 2.67 to 1. The input now, however, is the sun gear; the output again is the carrier, which is integral with both T_3 and the output of T_2. The reaction is the ring to ground, again through a one-way clutch.

For Neutral, T_3 is disconnected from the output by a cone clutch as shown in Fig. 7. T_1 and T_2 are disconnected by releasing the ground members. This is accomplished through a series arrangement of the one-way clutches and a single cone to ground. Park is provided by engaging a pawl with a gear integral to the rear carrier.

Grade retard is accomplished (see Fig. 8) by a four active face plate clutch which grounds the T_1 reaction, while freeing T_2 and T_3 through release of the forward and neutral cones. The T_1 is thus geared at 2.67 times the output. Since the stator is freewheeling, the reaction is against the engine only, so that propeller shaft torque is 2.67 times engine torque.

For reverse (see Fig. 9), a ground cone on the second turbine compounds the two planetaries for both reversal and reduction (1.78 to 1). The third turbine turns in the counter engine direction with the output shaft. The second turbine is stationary and is a reaction member within the torque converter. As a result, T_3 is driven in the reverse direction, contributing to the total reverse output ratio of 4.1 to 1.

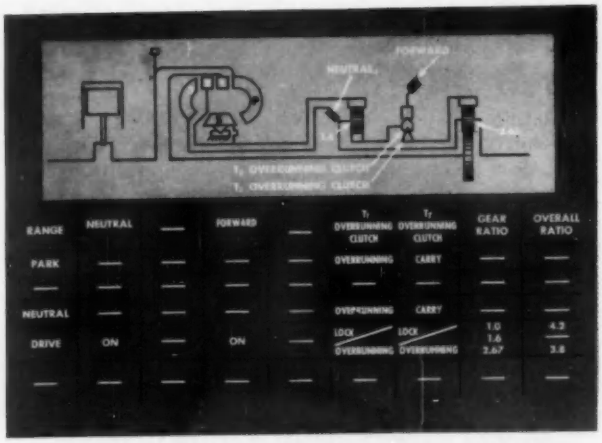


Fig. 7—Turboglide arrangement (neutral clutches)

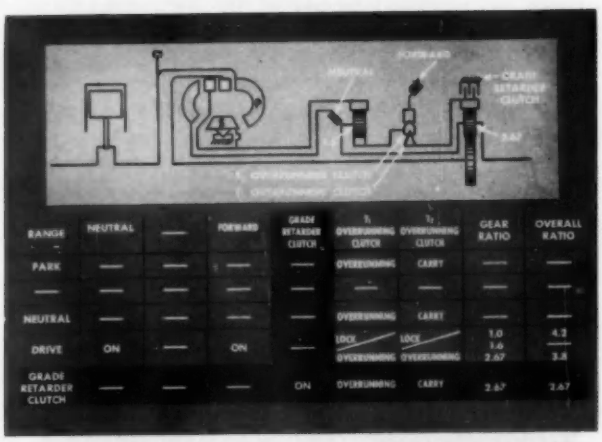


Fig. 8—Turboglide arrangement (grade retarder clutch)

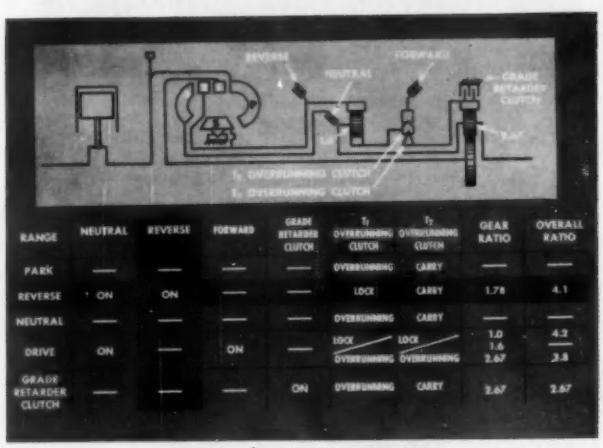


Fig. 9—Turboglide arrangement (reverse)

Performance

From the summation of the moments acting on the oil mass (see Fig. 11), it is clear that for maximum performance the total available torque should be transmitted through the turbine with the largest gear reduction. This, of course, means sequence gearing with the resultant power shifts. If shifts are to be avoided, the total available torque must be shared by the individual turbines, with minimum torque to the lowest ratio turbine.

For maximum total output, the direction of the moment or torques should be as shown in Fig. 11, so that the sum of the turbine torques is equal to the sum of the engine and stator torques.

The family of torque curves shown in Fig. 11 is arranged to illustrate direction as well as relative magnitudes. For maximum output at stall, the total available torque (engine plus stator) should be arranged to react against the first turbine (the largest gear multiplication). Thus, at stall, T_2 and T_3 torque must equal zero. The engine speed curve is primarily a pump function and is based on a selected stall speed and N/V factor. The curve characteristics between stall and maximum vehicle speed are established by the efficiency factor, so that the engine speed curve may be roughed in prior to establishing blade angles and gear ratios.

It now may be seen that with the first turbine running at 2.67 times the output rpm, its useful range is limited by its proximity to engine speed. The limit or freewheel point may be more or less than engine speed, depending on the final selection of blade angles.

At the speed shown, the second turbine should carry

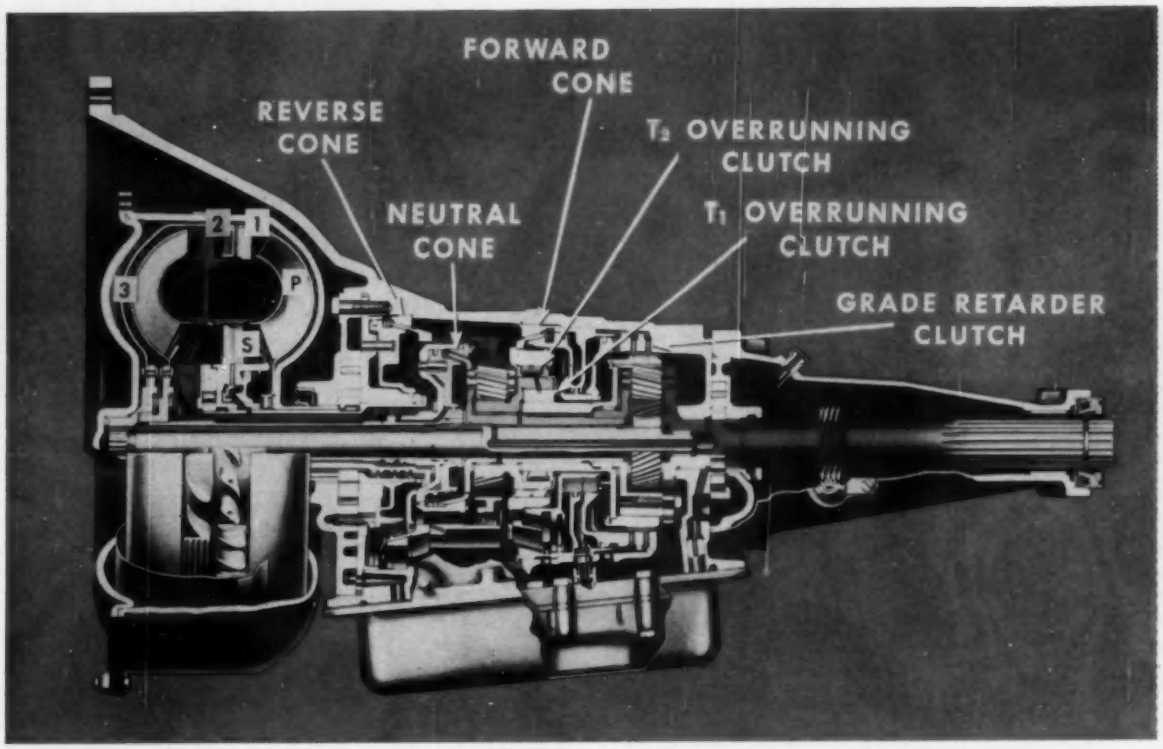


Fig. 10—Turboglide arrangement (power path)

as much of the available torque as possible. However, since T_3 must start at stall, the available torque at speed X must be split between T_2 and T_3 with T_2 carrying the larger share. With the second turbine running at 1.6 times output, its useful range is limited to speed Y. At this speed, T_3 torque must equal engine plus stator torques and (ultimately) engine torque at the freewheel point of the stator. Thus, the total output torque at any speed is equal to 2.67 times T_1, plus 1.6 times T_2, plus T_3 torque.

This torque distribution is optimum, and cannot be improved upon by subsequent blade design.

Turboglide Distribution

Turboglide blade development has resulted in the torque distribution shown in Fig. 12. The selection of a stator angle producing a high stall speed results in maximum output as a consequence of high input horsepower as well as high torque ratio. However, as with all highly regenerative stators, cruising efficiency is down and part throttle starts have a characteristic "loose" feeling. The dual blade angle eliminates these deficiencies by providing a low angle for tight connected operation for normal driving, while allowing high angle for maximum performance. Individual and total torque ratios for high and low angle are shown in Fig. 12.

The curve shown in Fig. 13 is the product of the above distribution. It represents the actual wide open throttle performance of the Turboglide with a Chevrolet 283 cu-in., 4-barrel carburetor engine. As stated previously, the Turboglide allows simultaneous modulation of both engine and transmission performance. For example, any performance value is available—from road load to wide open throttle low angle—simply by depressing the throttle. Further depression of throttle results in blade change and maximum performance.

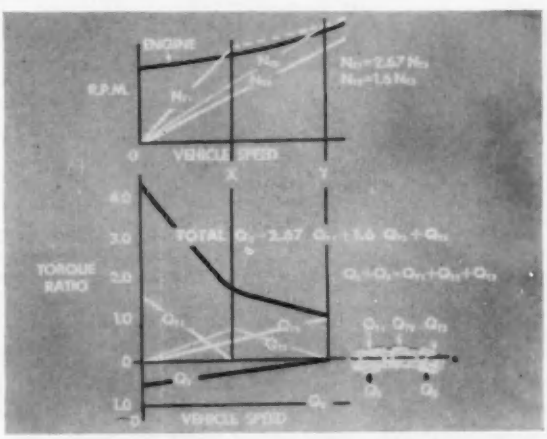


Fig. 11—Optimum wide open throttle performance

Control System

The control system is relatively simple. It contains the conventional input and output crescent pumps; a main regulator valve, which provides the necessary

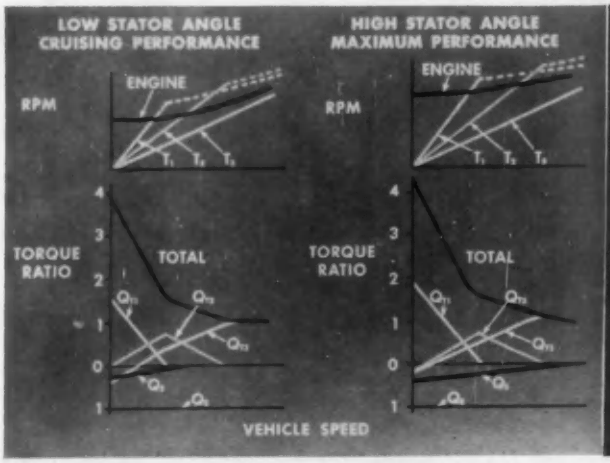


Fig. 12—Turboglide torque distribution

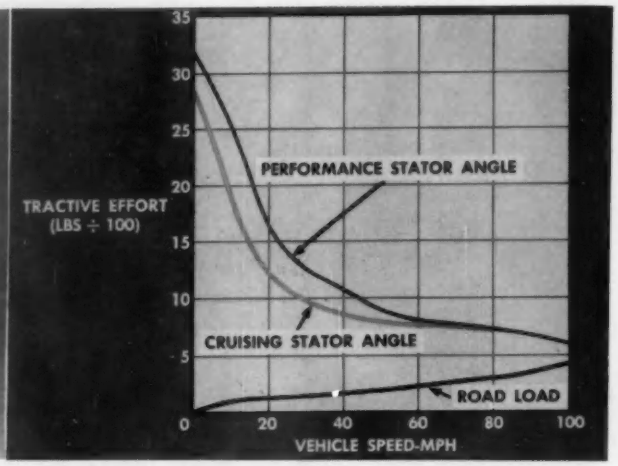


Fig. 13—Turboglide tractive effort

pressure for holding the various clutches and allowing the rear pump to bypass the front for a reduction in parasitic losses; and a vacuum modulator system, which varies the regulated pressure in proportion to engine torque, so that normal cruising is at minimum pressure (90 psi).

A manually operated selector valve routes oil pressure to the required clutches.

A detent or stator valve is spring loaded against the throttle linkage so that when it is depressed oil is exhausted on the forward side of the stator pistons, allowing converter pressure to force the piston to the high blade angle position. An accumulator and fixed orifice provide the necessary cushioning of the "garage" shifts. Converter cooling and charging pressure are ported through the main regulator valve; an exhaust restriction limits the maximum flow. The cooler return is routed to the lubricating passages, which contain a pressure limiting valve. A time delay accumulator prevents a sudden drop in line pressure when the throttle is quickly released.

The foregoing is an abstract of a paper presented by the authors at the SAE Annual Meeting held recently at Detroit.

Earlier descriptions of Chevrolet's Turboglide transmission appeared in AUTOMOTIVE INDUSTRIES, *Oct. 15, 1956 (starting page 50), and Jan. 1, 1957 (starting page 56).*

• • •

Model T Still Retains Ford Production Record

At a time of peak industrial production, it is interesting to reflect on a report issued by Ford Motor Co. The chronological account of the company's annual production since it was founded shows that it has yet to topple one record, which has stood for 33 years. That is the production record set by the Ford Model T in 1923.

Ford's total production of 2.2 million passenger cars in 1955—including all lines—topped the 1923 output of 1.8 million by a substantial margin. But the Ford car itself has been unable to match the record of its predecessor, the Model T. During record 1955, the company turned out 1.76 million Fords. The Model T record stands at 1.81 million.

It is also interesting to note that the year 1923 held the company's record for total vehicle production for 32 years. It was not until 1955 that Ford was able to top that previous all-time high period of 2.01 million cars and trucks.

The company produced 2.61 vehicles in 1955. Included were four lines of cars, compared with only two in 1923 (the Model T and Lincoln.)

Vickers Holds Demonstrations Of Its New Dynamic Test Stand

The first two of a series of demonstrations of a new Dynamic Test Stand for jet engine fuel controls were held by Vickers, Inc., on Jan. 28, 29, and Feb. 1 at its plants in Detroit. Attending were representatives of the Bureau of Aeronautics, American Airlines, Braniff Airlines, and Lucas-Rotax Ltd.

An orientation session included detailed discussion of the hydraulic and electronic circuitry. This provides for dynamic, in addition to static, testing of jet engine fuel controls.

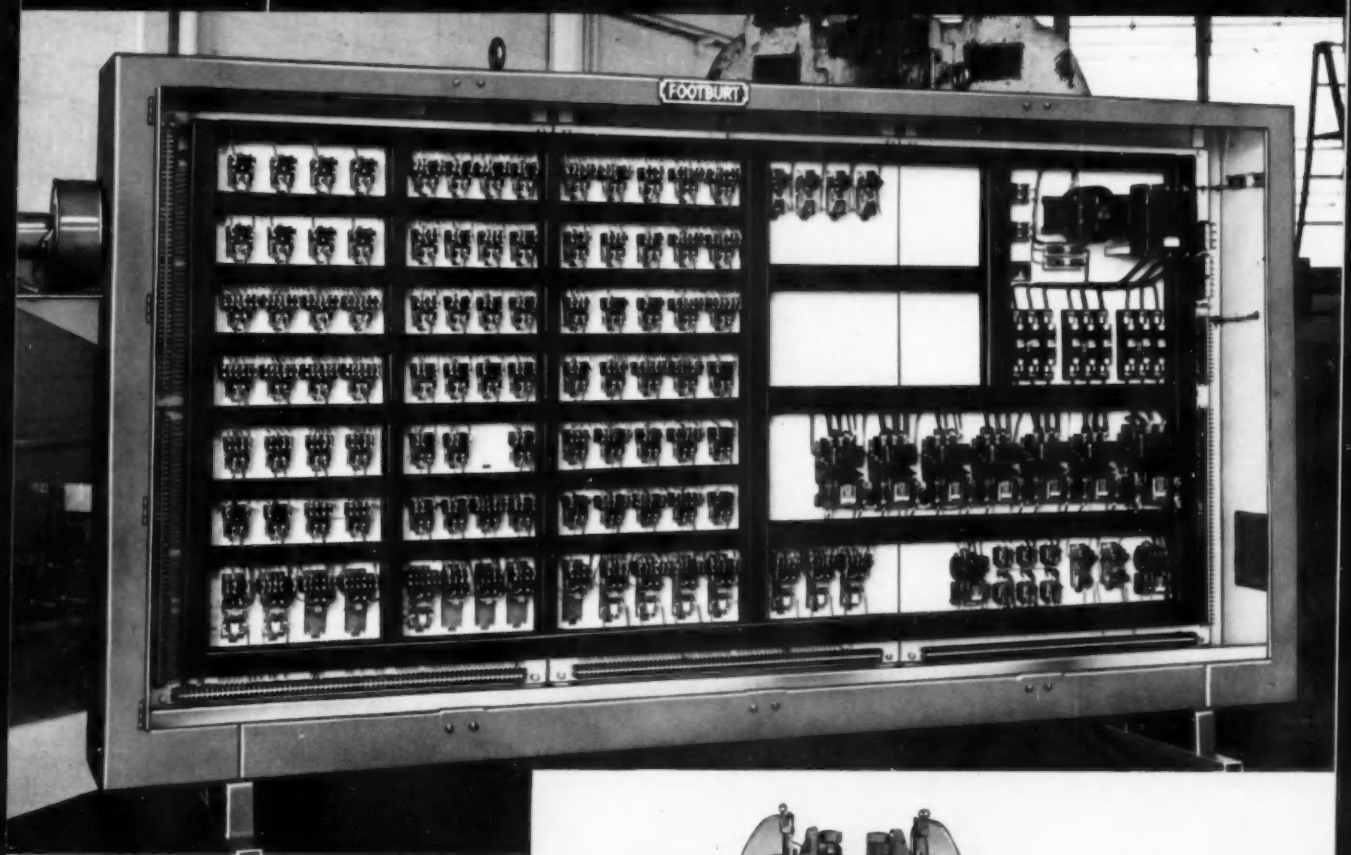
Following the orientation discussions, the stand was demonstrated on the controls for J-34 engines. The stand consists of two parts: (1) the test bench where the fuel control is mounted and (2) the electronic console which includes the computer section.

Future demonstrations will be scheduled for representatives of CAA, the Air Transport Association, overhaul and maintenance personnel from other airlines, and representatives of engine and airframe manufacturers.

Makers Take Closer Look At Diesel Market Growth

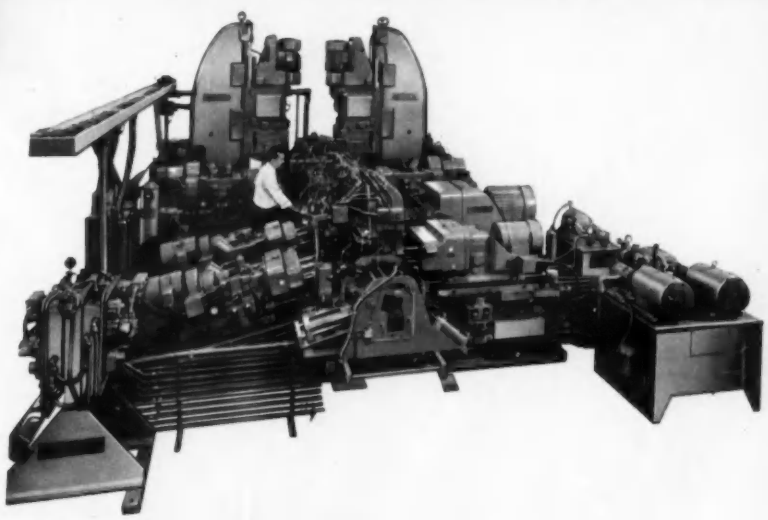
Due to the growth of the Diesel market, some truck builders who have not offered that type of power plant now are giving serious study to its possibilities. At least one is doing some major redesigning to accommodate a Diesel engine option in its largest models.

Another Manufacturer Uses G-E Control For Automotive Industry Machines



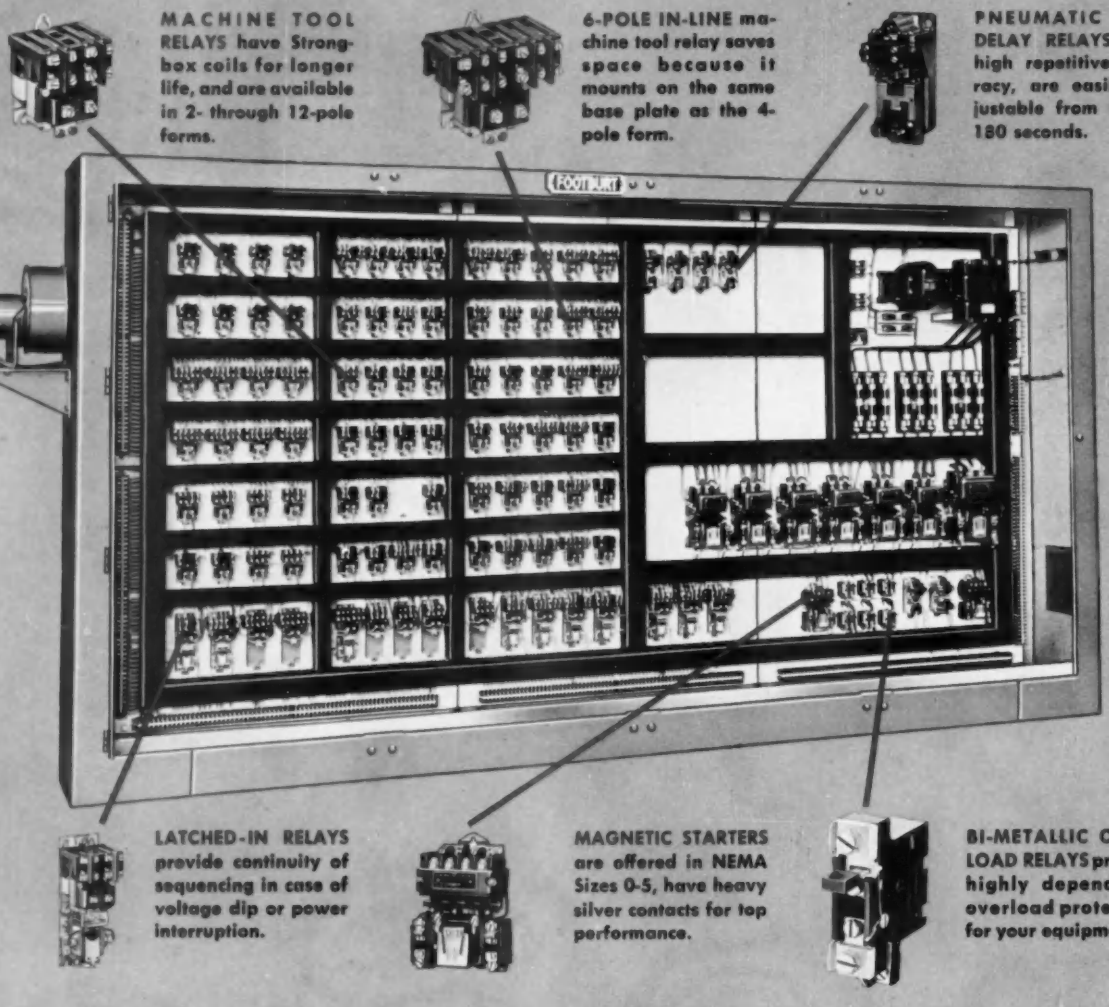
General Electric devices in the above panel control a ten-station, 39-spindle, hydraulic feed drilling machine that will be used in the plant of a major automotive manufacturer. Manufactured by The Foote-Burt Company of Cleveland, Ohio, the machine was designed to perform all operations automatically. This machine is one of three sections of a complete transfer line with each section capable of producing 130 parts each hour.

Components of the control panel were supplied by General Electric, and include 9 magnetic starters, 93 machine tool relays, and 6 pneumatic time-delay relays. In addition, 94 General Electric oil-tight push buttons, selector switches, and indicating lights are mounted on a small master control panel and on auxiliary control stations on the machine.



For a description of the G-E control devices used by The Foote-Burt Company in the panel for this machine, turn the page.

GENERAL ELECTRIC



MACHINE TOOL RELAYS have Strongbox coils for longer life, and are available in 2- through 12-pole forms.

6-POLE IN-LINE machine tool relay saves space because it mounts on the same base plate as the 4-pole form.

PNEUMATIC TIME-DELAY RELAYS offer high repetitive accuracy, are easily adjustable from 0.2 to 180 seconds.

LATCHED-IN RELAYS provide continuity of sequencing in case of voltage dip or power interruption.

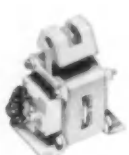
MAGNETIC STARTERS are offered in NEMA Sizes 0-5, have heavy silver contacts for top performance.

BI-METALLIC OVERLOAD RELAYS provide highly dependable overload protection for your equipment.

G-E Control for the Automotive Industry

Other G-E Control Devices for JIC Applications

OIL-TIGHT PUSH BUTTONS are offered in a wide variety of interchangeable operators and indicating lights. Lights and rings are available in six colors for flexibility and easy identification.



STRONGBOX SOLENOIDS have coils sealed against the entrance of oil, dust, and moisture for longer life. They're available in a full range of ratings in both push and pull forms.

These General Electric control devices are designed to give long service and the high degree of reliability required by automotive applications. Built to meet JIC Standards, G-E control provides easy installation, simplified maintenance, and highly dependable operation.

Whether for use on machines in your own plant or on equipment bought from suppliers, specify General Electric control. Your nearest G-E Apparatus Sales Office or Distributor has full information for you. Also, if you do not have a copy of "G-E Control for JIC Standards," write for bulletin GEA-6317 to Advertising Section 733-23, General Electric Company, Bloomington, Illinois.

GENERAL ELECTRIC

AUTOMATION NEWS REPORT

FEEDBACK

AUTOMATIC CONTROLS

PRODUCTION — VEHICLES — AIRCRAFT

By Samuel Cummings

SOLAR FURNACE

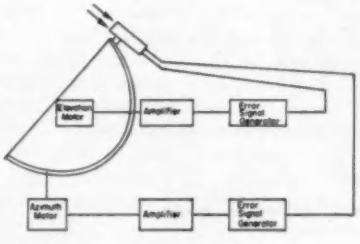
SOLAR energy focused to an intense heat in a man-made solar furnace has become an important research tool for the investigation of high-temperature materials for use in guided missiles, jet engine aircraft, and nuclear reactors. By testing materials in these furnaces, engineers can make many design decisions which might otherwise have to be delayed until expensive prototypes could be built.

Now, Arthur D. Little, Inc., has come up with the first in a new line of equipment for high-temperature research—a commercial model of its ADL solar furnace—which it is offering for sale to research laboratories.

The ADL furnace is simple in construction and is easy to operate and maintain. It consists essentially of a focussing mirror (60-in. diam), whose surface is coated with Stellite, a highly reflective substance; a driving mechanism to keep the device properly trained; a holder for the test material; and a shutter system for regulating the focused beam.

The sun tracking mechanism consists of two motors which rotate the parabolic reflector around the horizontal and vertical axes. The basic speed of the motors is adjusted so that the reflector follows roughly the course of the sun.

An electronic guiding mechanism (see illustration) is provided for longer testing periods. This mechanism is actuated by photo-multiplier tubes that generate an error signal when a passing cloud prevents the reflector from following the correct tracking path.



Schematic of electronic sun-tracking mechanism, which is incorporated in the ADL solar furnace

This error signal is amplified and algebraically added to the basic drive current of the motors.

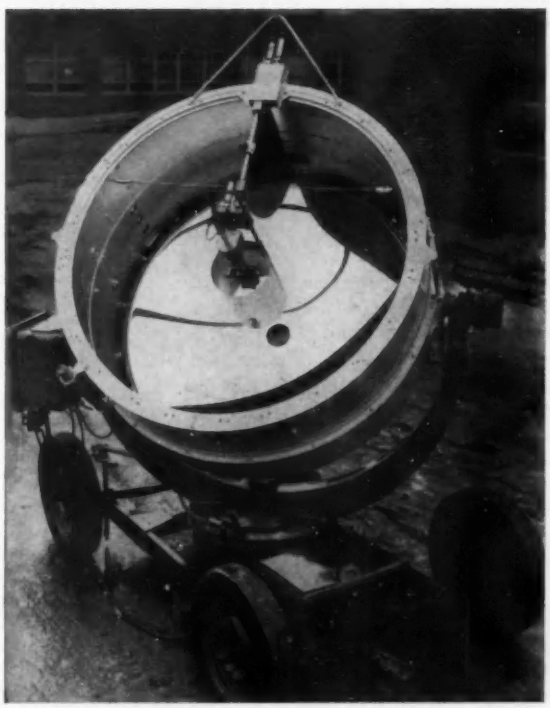
The sun can also be tracked manually by sighting it in a collimating tube and using potentiometers to correct the basic tracking speed of the motors.

The irradiated area of the sample, which can reach 3500 C, is 6 mm in diam. Although this area is admittedly small, physical properties such as melting point, vapor pressure, specific heat, and thermal conductivity can be measured.

The solar furnace has a number of advantages over conventional high-temperature furnaces, according to Dr. Peter E. Glaser, the Arthur D. Little engineer who designed it. For one thing, heat can be turned on and off almost instantaneously, or moderated rapidly through the shutter system. Then again solar heat is a clean heat. There is no contamination from thermochemical reactions—the sample is its own container—or from the combustion products of fuels, both troublesome problems in conventional furnaces.

It is difficult to forecast any possible fields of application other than research, says Dr. Glaser. Although he believes that temperatures as high as 6000 C are attainable in solar furnaces, he cannot foresee any industrial use for them—principally because of the economic factor. To melt large amounts of metals would require the development of a mirror many times larger than the present one—and this would run into millions of dollars. Present industrial furnaces will probably always be more economical, concludes Dr. Glaser.

(*Turn to page* 89, *please*)



ADL solar furnace generates temperatures up to 3500 C. All mechanical and electrical components are weather resistant.

BONDING TECHNIQUES

for Making

High Performance Primary Trainer

By
CLYDE I. YATES, Process Engineer
and
C. L. CAUDILL, Group Engineer
Temco Aircraft Corp.

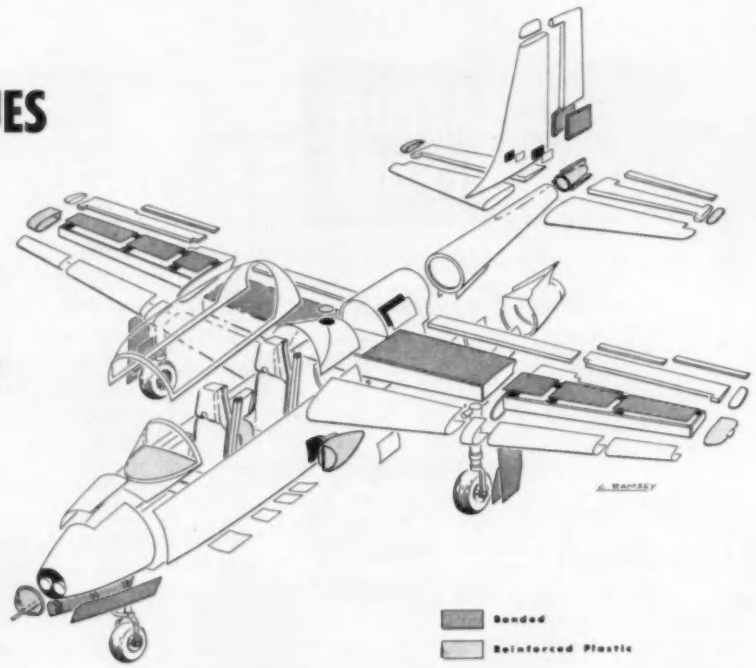


Fig. 1—Exploded view of reinforced plastic structures

TEMCO'S Model 51 is a high performance primary trainer that introduces the "feel" of jet powered aircraft to new pilots. In order to obtain this high performance and yet retain the stability and ease of handling required in a primary trainer, Temco designers took full advantage of the excellent strength-to-weight factors presented by structural adhesives and reinforced plastics.

Reinforced plastic structures, as illustrated in Fig. 1, were fabricated by conventional methods with materials that meet the requirements of Specification MIL-P-8013. One unusual type of construction was used in fabricating the air intake ducts. Male molds were made of wash out plaster to the D-shape design dimensions. The duct walls were made by laminating resin impregnated glass-fiber reinforced plastic around this male mold. In order to give rigidity to the flat section of the "D," a thin section of fiberglas honeycomb was built into a sandwich structure that provides ample strength to prevent collapse of the duct and yet be very light in weight. A cross section of a duct is shown in Fig. 2.

Sandwich type structure, as shown in Fig. 1, consisting of aluminum skins bonded to aluminum honeycomb core, was selected for use on the landing gear doors and on wing panels. Advantages gained by the use of this type construction are that it (1) provides a high strength to weight ratio, (2) has good stiffness properties, (3) requires fewer detail parts, (4) saves internal space, (5) provides good exterior aerodynamic surfaces, (6) requires less assembly time than other type structures, (7) provides better distribution of stress through the joints than conventional metal fasteners.

Adhesives for bonding Model 51 parts were chosen from those qualified to specification MIL-A-5090 on the basis of processing characteristics plus reliability of the fin-

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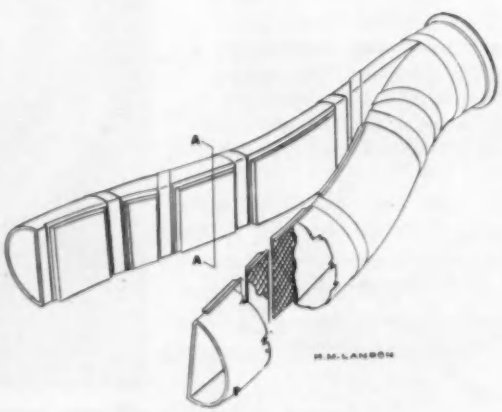


Fig. 2—Cross section of duct

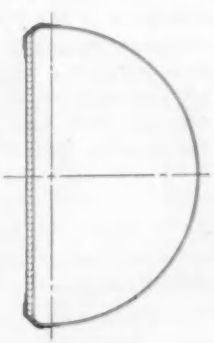


Fig. 2A
Section A—A
in Fig. 2

Defense Dept. has finally finished counting the number of items in its supply systems. The total comes to 3,128,613 different items. The Pentagon's next job is to reduce this huge total by standardization.

By the end of 1957, cars, trucks and buses may be rolling on some completed stretches of highways now being built under the new roadbuilding program. Work on nearly $500 million worth of such highways had started by early February.

Industry is slated to get more relief from the annoying task of filling out endless Government forms. The Budget Bureau says that it will test reporting blanks to determine whether the information sought is essential to the work of the agency concerned and whether it can be found in existing reports.

Fuel burned by the Government vehicle fleet in 1956 added up to over 183 million gal. This means that all units, heavy trucks and buses included, made an average of 9.4 miles to the gallon in traveling 1.7 billion miles.

In 1955, a total of 5.605 million internal combustion engines (except automotive and aircraft) were shipped to other companies or produced and incorporated into products of the same company, according to Bureau of the Census. Of this total 4.602 million engines valued at $543 million were shipped to other companies. Of the total value of engines shipped in 1955, gasoline engines accounted for 40 per cent; Diesel engines, 35 per cent; outboard engines, 19 per cent; and gas engines, six per cent.

Ford Mahwah Fire Protection Setup

(*Continued from page 42*)

sure by the little automatically-controlled jockey pump which has adequate capacity to handle normal system leakage. If fire causes some sprinklers to open, however, the attendant drop in line pressure will be beyond jockey pump capacity and will cause the 1500-gpm motor-driven fire pump to start. If line pressure then continues to drop, indicating either that the motor-driven unit has failed to start (possibly because of power failure) or that demand for water is greater than 1500 gpm, the Diesel starter is activated automatically and the 2500-gpm pump goes into service.

To stamp out small fires quickly and to help combat larger blazes, the company provided 102 hose reels with individual manual control valves and supplied through 1½-in. pipes from the overhead sprinkler feeder lines. Each reel has 100 ft of hose and reels are positioned so that every spot in the building can be reached with a hose.

The minute water begins to flow anywhere in the sprinkler system an Auto-Call system not only sounds the alarm and indicates the location of water but records this information on punched tape. The master recorder is situated in the plant security office where there is always a man on duty. A second unit is placed in the plant engineer's office and a third in the plant maintenance department.

They have also provided a 300,000-gal elevated storage tank kept full by its own motor-driven pump with water from the plant supply line. If the ground storage tanks are exhausted or both motor-driven and Diesel-driven fire pumps are knocked out, water from the elevated tank can be discharged into the plant fire loop providing an initial head of 125 ft. A special line extending half way up the tank permits use of half the water for normal plant use if township pressure fails, but a minimum of 150,000 gal is always availble for fire fighting and cannot be discharged except through the fire loop.

There is an emergency connection from the plant supply line to the fire loop so that, if all other sources of water and pressure are exhausted, a valve can be opened and township water at 40 to 55 psi pressure can be utilized.

Finally, there are two fire trucks with foam and chemical equipment.

A single 150-hp tractor uses an average of 8½ gal of petroleum fuel an hour.

●

The U. S. produces 70 per cent of the world's passenger cars.

●

At an average rate of 30 mph, it would take an automobile more than 11 years to travel over the 3,012,520 miles of rural roads in the U. S. today.

●

About 85 per cent of all vacation trips in the U. S. are made by automobile. Average mileage per round trip is 1018.

●

U. S. farmers today own seven million motor vehicles and 4.5 million horses and mules, compared to 5.6 million and 11.9 million, respectively, 10 years ago.

●

U.S. spends 25 cents out of every revenue dollar on military "hard goods"—the thousands of metal and other durable items required to support an up-to-date Army, Navy, Air Force.

●

The military payroll alone accounts for about half the total cost of national security.

●

Every 24 hours, the Federal Government pays out $100 million just for national security.

●

Total Government spending for missiles in fiscal year 1957 will hit $1.2 billion. This is more than twice as much as the total sum spent by the Air Force and the Navy together for all military aviation in 1941.

●

Maintaining and expanding the world petroleum industry in the next 10 years will require $115 billion in capital expenditures—nearly twice the annual budget of the U. S. Of this sum, $73.5 billion will be spent within the U. S.

News of the MACHINERY INDUSTRIES

By Thomas Mac New

Linde's Unionarc Welding Process

A NEW semi-automatic metal arc welding process, called Unionarc, uses a continuously fed wire electrode which is magnetically coated with flux and shielded in a gas atmosphere. Developed by Linde Air Products Co., Div. of Union Carbide and Carbon Corp., the new welding process for carbon steel will be demonstrated publicly at the American Welding Society Show in Philadelphia the week of April 9. Unionarc welding can be used to weld across gaps and along seams containing moderate amounts of rust, scale, and moisture without effect on weld soundness.

Basically, as the bare wire electrode is fed through the welding torch, the magnetized flux is fluidized in a stream of welding grade carbon dioxide gas. At the torch nozzle, the magnetic field created by the electric current passing through the wire, magnetizes and attracts the flux to the wire. As a result, the wire is coated as it is fed into the arc. As the flux melts, it does four important jobs. First, it stabilizes the arc and the stream of molten metal passing through it to the puddle, and protects the puddle from atmospheric contamination. It then refines the molten metal by deoxidation. Third, it provides the desired control of weld contour by its effect on surface tension. Finally, the desired cooling rate of the weld metal is provided by its blanketing and insulating action.

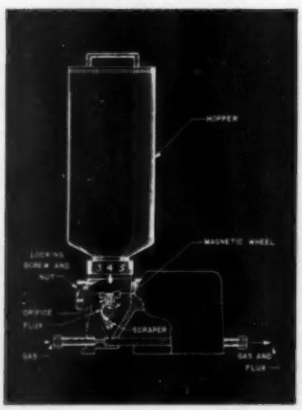
Arc characteristics of Unionarc welding are similar to those of covered electrode welding. Under most conditions, metal transfer is spray-type with very little spatter. Spatter produced is not tenacious and can be removed by wiping or light brushing.

Linde's Unionarc welding machine consists of four basic pieces of equipment—aircooled welding torch, flux powder dispenser assembly, welding control, and mechanical assembly.

Torch

The torch is rated at 450-amp continuous duty and is designed for the Unionarc welding of carbon steel, using 3/32 or 3/64-in. welding wire. The powder-gas stream is directed through a grooved insulator in the torch to four orifices in the nozzle. The insulator also isolates the effect of the magnetic field around the wire, so that the flux is attracted only to the wire in the nozzle near the point of use and not to other torch parts along the flow path. A soft rubber sleeve on the back of the insulator protects it from abrasion where the flux enters the torch body. A two-button switch on the torch handle controls the entire welding operation.

Side view of Linde's new Unionarc semi-automatic welding machine showing wire supply mounted on rotating assembly.



Powder or flux dispensing unit. Note the calibrated ring for setting the amount of powder flowing from the hopper onto the magnetic wheel. Flux is scraped off the wheel and fed into a distribution chamber where it is fluidized with carbon dioxide gas. Hopper holds a normal eight-hr. welding supply.

Torch nozzle of the Unionarc machine combines flux, CO_2, and the continuously fed welding rod. As current flows through the rod, the flux is magnetized and attracted to the rod. The powder-gas stream passes through a groove in an insulator in the torch to form orifices in the nozzle.

New Welding Process Uses Combination of Carbon Dioxide Gas and Powdered Flux to Produce Quality Welds and Provide Allowances for Production Variables

Powder Dispenser

This unit is the flux-storage and metering device and can be functionally divided into three assemblies:

(1) Hopper assembly. Under operating conditions, the hopper body assembly is pressurized by gas at about four psi through the pressure tube. The hopper assembly can be screwed into or out of the body of the powder dispenser to control the quantity of flux released into the gas stream. When the hopper is down, the flux orifice is brought closer to the magnetic drum and less flux is delivered. A locking screw assembly holds the hopper at the setting selected. A calibrated ring on the hopper indicates the position of the flux orifice.

(2) Magnetic wheel assembly. A magnetic wheel mounted on a drive shaft is positioned directly beneath the nozzle of the hopper assembly. The flux passes down from the hopper assembly and adheres as a layer to the surface of the rotating magnetic wheel. As it rotates, a rubber scraper, positioned beneath it, removes the flux layer from the drum and allows it to fall under gravity into the distributing chamber. Here the flux is suspended in the gas stream and is carried along toward the torch.

(3) Gas-flux control valve assembly. A four-way gas solenoid valve, a check valve and a powder pinch valve comprise the powder dispenser control elements for the gas-flux stream. The gas solenoid valve is electrically controlled through the two-button torch switch and is so designed that whenever welding is stopped, the machine is immediately ready to deliver a usable gas-flux mixture to the torch when welding again begins.

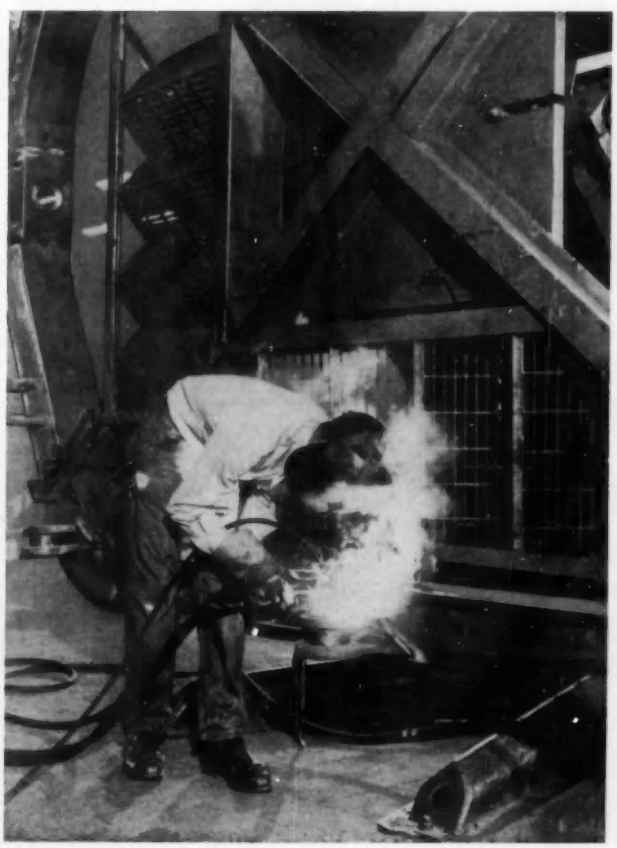
Welding Control

Wire feed rate is maintained constant through the action of an electronic governor, and the power supply itself corrects for changes in the arc length by varying the current delivered to the arc. In this way, the wire melts at a faster or slower rate, depending on the changes in the arc length, and thus the arc is brought back to its pre-set value.

Besides maintaining a constant wire-feed rate, the unit also controls the operation of the welding current contactor, the gas-solenoid valve and the wire pack drive motor.

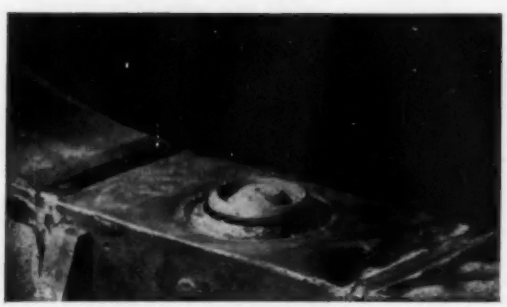
Mechanical Assembly

Power for feeding welding wire is supplied by a special d-c shunt motor. The gear reduction unit consists of two sections of gearing, which reduce the speed to that required at the wire feed roll. A spring-loaded pressure roll provides the back-up force necessary for positive non-slip wire feed. Nylon lined wire guide inserts for the wire sizes employed are inserted



Caterpillar Tractor Co. has cut welding time 55 per cent on bulldozer C-frame assemblies. A 34 in. long, ½ in. fillet weld in the downhand position is completed in seven minutes. In the illustration at right the operator is welding a bracket to a C-frame. These brackets are welded with single fillet and J groove joint designs. Two or three passes are used for a ⅜ in. fillet weld, while only one pass is required for a ½ in. weld in the J groove.

Quality of the weld is shown (below) in the flat welds used to join this casting to a Caterpillar C-frame assembly.



into the inlet and outlet wire guides.

Unionarc welding heads are available in two separate gear ratios, a 95:1 ratio and a 54:1 ratio. The following table lists the recommended currents for individual wire sizes for these heads.

Wire Diameter (inches)	Welding Current—Amperes (max.) 95:1 Ratio (42 rpm)	54:1 Ratio (74 rpm)
3/64	200	450
3/32	450	Not Recommended

The feed roll shaft extends through the gear reduction unit and is also used to drive the magnetic drum in the powder dispenser.

The machine uses welding wire supplied in "Pay-Off Pak" containers. A 115-volt, 60-cycle, 1/20-hp motor is used to turn a rotary table assembly holding the pack. As the wire feeds off the drum during welding, it passes through the eye of an actuating arm on a limit switch. As the table turns, welding wire pays out from the drum at a faster rate than it is being pulled by the welding head. This causes the wire to bow out from the drum, pushing the actuating arm with it. When the actuating arm has been pushed to its extreme position, the movement of the rotary table ceases. As the welding head continues to feed wire, the bow in the wire is reduced, drawing in the actuating arm and the rotary table begins to turn again. This cycle is repeated throughout the welding operation.

Welding Wire Selection

Wire of various diameters can be used with Unionarc welding; however, the requirements of most welding applications can be met with the wide operating ranges of 3/32-in. and 3/64-in. diameter wires. The present Unionarc equipment was designed around these two wire sizes. Wire of 3/32-in. diameter is generally used for welding in the flat and horizontal positions. Wire of 3/64-in. diameter can be used for all position welding — flat, horizontal, vertical and overhead.

Flat and Horizontal Positions

For flat and horizontal welding, wire of 3/32-in. diam is used over a current range of approximately 350 to 450 amp d-c reverse polarity with a flux-to-wire ratio of 0.5 lb. Single-pass fillets up to one-inch leg size can be made in the flat position and single-pass fillets up to ⅝-in. leg size can be made in the horizontal position. Single-pass 5/16-in. size lap fillets can be easily produced. Larger fillet welds are usually made by multi-pass welding. Undercut-free fillet welds can be produced without difficulty even with high welding currents and with speeds on the order of 25-ipm.

Butt welds can be made in the flat position. Multi-pass techniques are used for welding thick materials. Root passes can be readily applied in joints where gaps are encountered, and in many instances the process will be ideal for providing backing passes for submerged arc welding.

All Positions

Welds can be made in all positions with 3/64-in. diameter wire and flux-to-wire ratios in the range of 0.3 to 0.6. Welding currents used vary from 125 to 250 amp d-c reverse polarity, depending upon joint design and position of welding. In all positions, lap, tee-fillet and butt welds can readily be produced in all thicknesses of material. Multi-pass techniques are used on thick material. Both straight line and weaving techniques can be used.

Weld Quality

The basic drive behind the development of Unionarc welding was the need for a production process — a method of fabrication which would produce quality welds every time it was applied to standard types of steel, and yet lower production costs by building allowances for production variables into the process and its equipment. Primarily for this reason, all tests were conducted on steels

(*Turn to page* 91, *please*)

UNIONARC WELDING

HORIZONTAL FILLER WELD—¼-IN. SIZE

Rod Size, in.	3/32
Welding Current, amps	400 (DCRP)
Welding Speed, ipm	20.0
Arc Time, hr/100 ft	1.0
Deposited Metal, lb/100 ft	13.3
Welding Rod Consumption, lb/100 ft	13.3
Flux Consumption, lb/100 ft	6.7
Carbon Dioxide Consumption, cu ft/100 ft	35

COST

HORIZONTAL FILLER WELD

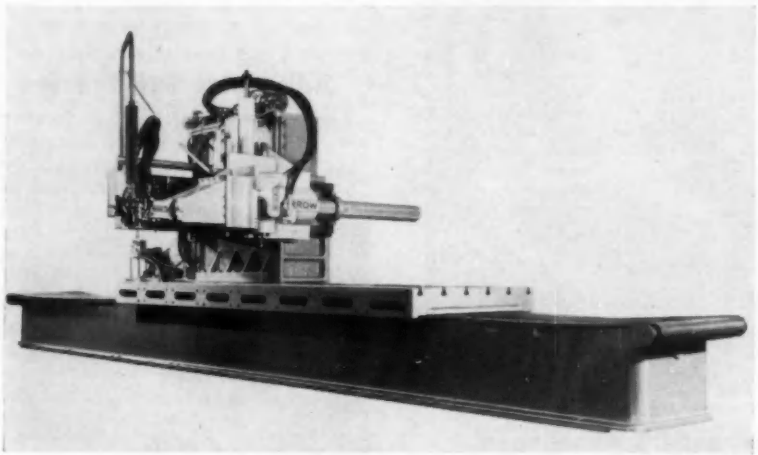
¼-IN. SIZE—100 FT OF WELD

Materials Cost		Unionarc Welding
Welding Rod	13.3 × $0.165*	= $ 2.19
Flux	6.7 × $0.35	= 2.34
Gas	35 × $0.015	= .05
Sub-Total		$ 4.58
Labor & Overhead Cost		
	1.00	
Labor at $2.00/hr	.5 × $2.00	= $ 4.00
Overhead at 150% of Labor Cost	1.5 × $4.00	= $ 6.00
Sub-Total		$10.00
Total		$14.58
Total Eliminating Overhead		$ 8.58

* Includes license fee.

NEW PRODUCTION and PLANT EQUIPMENT

FOR ADDITIONAL INFORMATION, please use reply card on PAGE 69



Arrow profiler is capable of doing 360-deg profiling, three-dimensional contouring, and swarf machining on steel, aluminum or titanium.

Machine for Profiling and Swarf Machining

HIGH-PRODUCTION 360-deg profiling, three-dimensional contouring and swarf or twist machining can be performed on steel, aluminum or titanium with a profiler now being manufactured. Using a highly-responsive hydraulic tracing valve, the operator manually traces a template and the cutting tool machines profiles or three-dimensional contours. Accuracy is said to be within 0.005-in. For swarf or twist cuts, the spindle is mounted on arc-shape ways, permitting the spindle to pivot 20 deg either side of vertical center line. The pivoting action of the spindle is actuated by a second tracing valve mounted on the cross carriage.

The profiler is equipped with a 20-hp hydraulic-powered spindle having speeds from 37 to 3000 rpm, giving it range and power to machine steel as well as aluminum and titanium. Speed changes are made through pick-off gears, and provide up to 30,000 lb-in. of torque at 37 rpm. The table measures 42 by 144 in., with 136 in. travel. Table feed is 0 to 40 ipm with rapid traverse of 100 ipm. Six full length T-slots provide clamping facilities for tooling or fixtures. A curtain protects the ways from chips and dirt. The profiler also features automatic lubrication to all working surfaces. *Arrow Engineering Co., Inc.*

Circle 30 on postcard for more data

Industrial Switch

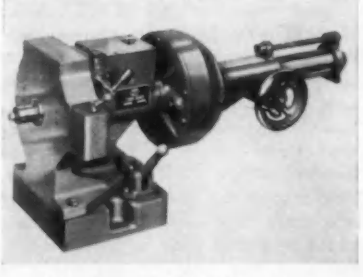
ESPECIALLY designed for applications where unusually heavy concentrations of dust, lint, oil, or coolant seepage are present, a heavy-duty industrial safety switch is available in the new NEMA Type 12 oil and dust-tight enclosure. The unit incorporates the company's heavy-duty Style HCI single-throw, double-break fusible or no-fuse switch mechanism. It meets JIC standards and NEMA HD standards, and is obtainable in ratings of 30 through 200 amp, 240 through 600-v, two and three-pole construction. *General Electric Co.*

Typical type H, style HCI industrial switch in oil-tight and dust-resistant NEMA 12 enclosure

Circle 31 on postcard for more data

Low-Cost Borer

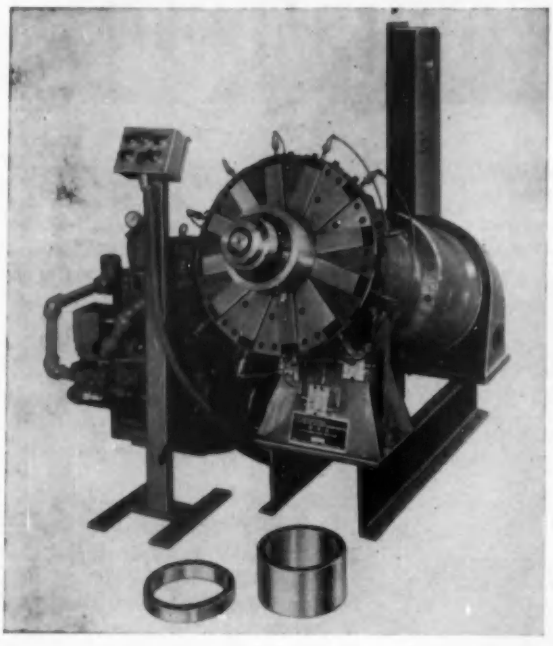
CALLED the Hydro-Borer Model C-4, a low-cost borer is said to offer precision boring heretofore found only in larger and more expensive types of boring machines. Tolerances of ±0.0003-in. and finishes to 30 microinches are achieved within its work range. It is pointed out that this kind of precision boring can be built into production setups inasmuch as the C-4 can be mounted on any type of base. Fixtures can be mounted directly on the face, 90-deg to the spindle. The unit is optionally furnished with an automatic trip and spindle return.



Greenlee model C-4 Hydro-Borer

Spindle is 1¼-in. diam with a No. 2 Morse taper. The taper can be supplied either concentric or eccentric. Eccentric taper permits increasing bore diameter a total of 0.014-in. in increments of 0.001-in. without resetting the tool bit. Feed is available in one of two ranges, either 0.002 to 0.004-in. or 0.0035 to 0.007-in. The machine feeds in either direction by reversing rotation, and has an adjustable stop in either direction. *Greenlee Bros. & Co.*

Circle 32 on postcard for more data



Grotnes 15-H-215 expander, the first of the company's "H" series, has a peak draw bar pull of 215 tons at 3000 psi hydraulic system pressure. Applications are forming and sizing of cylindrical, conical and polygonal parts which include tanks and jet engine components in both sheet metal and heavy ring categories.

First of New Series of Expanders Announced

THE 15-H-215 expander, having a peak draw bar pull of 215 tons at the maximum hydraulic system pressure of 3000 psi, is the first of a new series with capacities from 60 to 1450 tons draw bar pull. The line incorporates added flexibility as to range of shapes and sizes of parts that can be handled in one basic machine by interchanging the draw bar, cone, jaws and table. The company states these expanders find their principal application in the forming and sizing of cylindrical, conical and polygonal sheet metal and tubular parts, such as tanks and particularly rocket, missile and jet engine components in both sheet metal and heavy ring categories. Accuracy up to 0.004-in. TIR can be obtained.

A duplex type variable delivery pump, reservoir, oil cooler, piping and valves comprise the hydraulic system, which is capable of operating the machine at from two to six complete cycles per minute. The unit shown has a speed of approximately two cycles per minute. Regardless of overall cycle time, the expanding rate can be varied by means of a pilot motor operated adjustment. This is important when handling some types of metals, and when the amount of expansion required is high.

Jaw diameter is infinitely adjustable within the diameter range. Load carrying surfaces of the jaws, which have replaceable wear-anti-friction shoes, are always supported by the cone. In addition, the jaws are always kept in contact with the cone by push-back springs or hydraulic or pneumatic cylinders.

The expanders can be installed so as to operate in a vertical, horizontal or oblique position, depending on the size and type of jaws and cone.

With the draw bar and cone arrangement shown in the photograph, 2½ sq in. of stainless steel having a yield strength of 100,000 psi can be expanded. The test part shown is 1045 steel, having an ID of 8 in., a cross-sectional area of 4.55 sq in., and a yield strength of 60,000 psi. This part is shown placed directly on the jaws. Normally, tool steel dies are used between jaws and the part. *Grotnes Machine Works, Inc.*

Circle 33 on postcard for more data

Cutting Compound

ALUMINUM can reportedly be machined or ground without stain or discoloration by using a straight oil compound developed recently. Called International Compound No. 1231-A, this stain-free coolant is said to possess excellent lubricating properties which protect both the work and moving parts of the machine.

According to the manufacturer it penetrates to the point of contact swiftly and prevents premature loading of grinding dust on the wheel. This same action is claimed to increase the life of cutting tools by virtually eliminating the welding of chips or "bugs" on the tool. Chips are drained off continually.

Completely free of fats, the compound is a special blend of mineral oils and synthetics that will not become rancid. *International Chemical Co.*

Circle 34 on postcard for more data

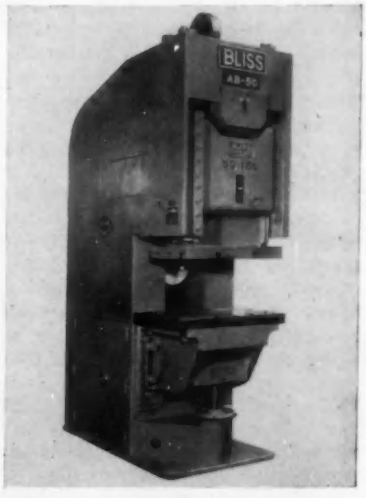
Adjustable Bed Presses

INTRODUCTION has been made of a newly-designed line of adjustable bed presses, featuring a fully enclosed box type frame. The 50-ton press illustrated is the first size to have been built, but the complete line includes capacities ranging from 50 to 150 tons.

These are fully enclosed presses with a box-crown, box slide, and inbuilding of all controls. Air controls and the recirculating oil unit are enclosed on the left-hand side of the press; the press and motor controls are similarly flush-mounted on the right-hand side. Other features include a fast-acting air friction clutch and brake, an adjustable rotary limit switch, and bronze-bushed bearings at the frame, connections and gibs.

The 18 by 24-in bed of the 50-ton model illustrated can be raised or lowered a distance of 9 in. making possible a shut height adjustment from 11 to 20 in. and thus suiting it for a variety of unwieldy stamping and forming work. This model is 37 in. wide and 74 in. front to back. *E. W. Bliss Co.*

Circle 35 on postcard for more data

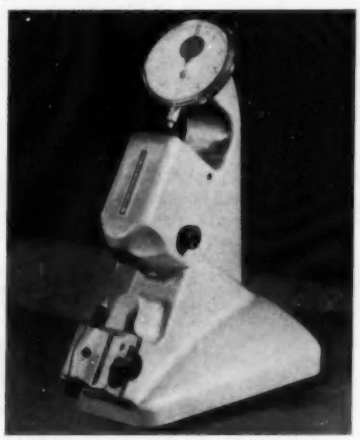


Bliss 50-ton adjustable bed press

Thread Checker

ANNOUNCEMENT has been made of a new gage capable of checking pitch diameters of any threaded part having external screw threads up to 1½-in. diam and of any specified pitch. The instrument can be operated mechanically to obtain readings shown on a dial graduated in 0.0001-in. Or, for more precise measurement it may be adapted for use with the company's single-column Precisionaire air gage and Plunget air gaging cartridge, or with the electronic Accutron amplifier and Electrojet pick-up unit.

The device uses one pair of gaging



Sheffield thread checker

tips for each pitch of thread to be checked. A knob located on the gaging head enables selection of either a 16 or 40-oz gaging pressure; other gaging pressures being available to meet special requirements. Parts are rolled slowly into position between the gaging tips, and pitch diameter variations are read plus or minus from zero on the indicator dial. Setup is made from a master thread plug or a previously-calibrated part. *The Sheffield Corp.*

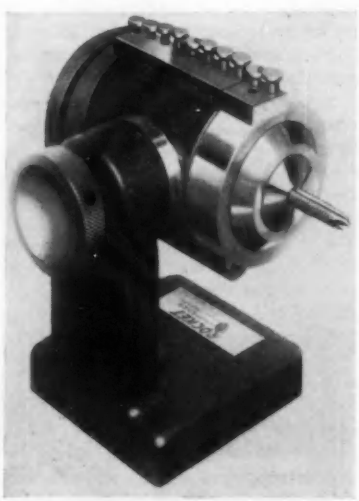
Circle 36 on postcard for more data

Tap Sharpener

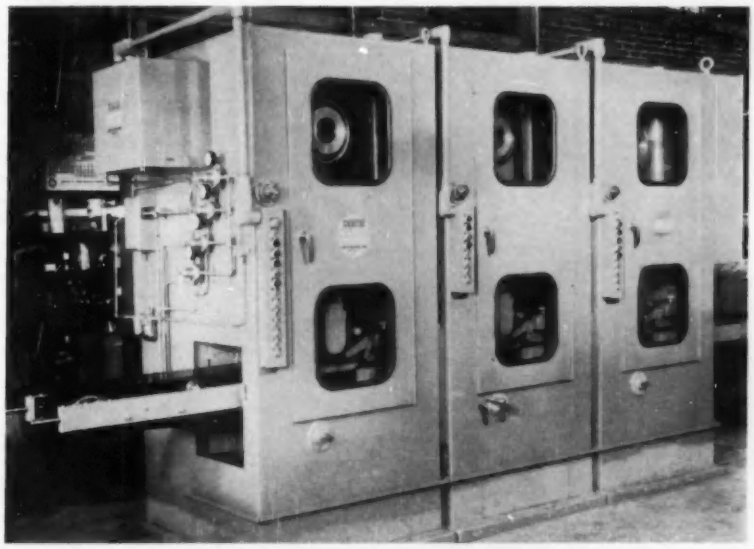
DESIGNATED as the 60 Series, a tap sharpener has been announced which will handle 4-, 5-, and 6-flute taps and has increased collet capacity to a maximum of 2¼ in. Push-buttons control the radial relief and provide indexing for the amount of turn of the tap. The head is adjusted by means of a knurled knob from 0 to 90 deg angle to the grinding wheel.

Designed to sharpen either left or right-hand taps, the sharpener requires about 45 sec to set up or change taps, and does the sharpening in minutes. It can be used on any surface grinder with a magnetic chuck or bolted to the work table. *Rockford Die & Tool Works, Inc.*

Circle 38 on postcard for more data



Rockford 60 Series tap sharpener



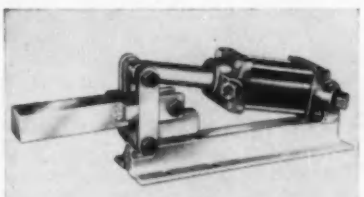
Grinding and Polishing Machine

Illustrated is the Model R-600C-3 "Straight-O-Matic" grinding and polishing machine, a unit employing three abrasive belts over one conveyor belt and equipped with wet grinding, oil mist applicator, automatic tracking, and pnematic tensioning of the 10-in. wide abrasive belts. It is said to make possible a three-grit polishing sequence, a three-step stock removal for sizing, or combinations of polishing and grinding. (Curtis Machine Div., The Carborundum Co.)

Circle 37 on postcard for more data

Heavy-Duty Clamps

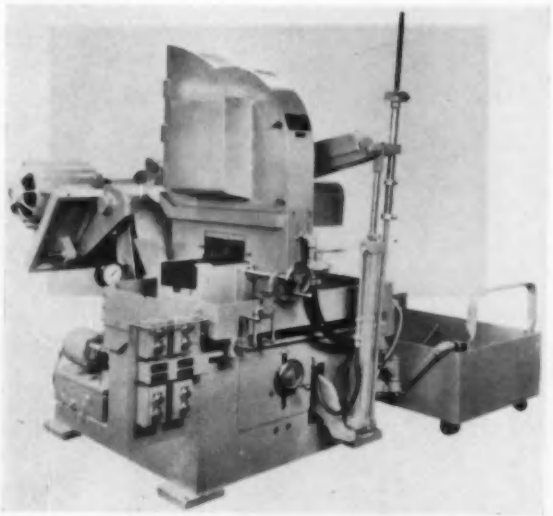
THE addition of new heavy-duty clamps to a line of manually and air-operated clamps, has been announced. The hand clamp is available in four models with either a solid bar —Models VS-200(HD) and VS-400-(HD)—or channel bar—Models V-200(HD) and V-400(HD)—of cold rolled steel, with clamping pressures of either 200 or 400 lb. The two air (or oil) operated clamps—Models AOS-200(HD) and AOS-400(HD)—have the solid-bar features for auto-



Lapeer Model AOS-400(HD) clamp

mation applications. Air can be supplied from right or left by rotating clamp cylinder. Failure of air or oil pressure will not release the clamp. *Lapeer Manufacturing Co.*

Circle 39 on postcard for more data



Campbell Model 481 wet abrasive oscillating cutting machine cuts practically any metal within its capacity of eight-inch square solids, including corrosion-resisting and hardened steels.

Wet Abrasive Oscillating Cutting Machine

DESIGNATED the Model 481, a wet abrasive cutting machine recently announced permits the cutting of bar stock, tubing and other shapes in ferrous and non-ferrous metals, including corrosion-resistant steel as well as hardened and annealed steels. Equipped with a 26-in. diam abrasive cutting wheel, it will cut metals within its capacity of eight-inch square solids with a minimum of burr. The Model 481 is an oscillating type machine in which the wheel feed and work clamps are hydraulically operated and the work bar is hand-fed. Through its oscillating motion, the amount of abrasive wheel contact is materially reduced and cutting is performed with a minimum of wheel pressure.

The machine is furnished with a 25-hp, 1800-rpm, totally-enclosed, fan-cooled motor to drive the abrasive wheel. Drive from the motor to the spindle is through multiple vee belts. The oscillating unit is driven by a one horsepower geared-head motor, at a constant speed. The wheel arm is mounted on an oscillator link mechanism, causing the abrasive wheel to move back and forth across the work piece at the same time that it is fed hydraulically through the workpiece.

In the coolant system, a wheel-mounted, separate coolant tank permits easy removal for chip cleaning. The coolant is pumped through a hose into the front of the wheel guard. An adjustable coolant box, equipped with baffle plates, between which the abrasive wheel turns, assures wetting of both sides of the abrasive wheel and guidance of coolant to the cutting area. Control of coolant is by means of a shut-off valve. *Campbell Machine Div., American Chain & Cable Co., Inc.*

Circle 40 on postcard for more data

Bearing Tester

CONSISTING of a metal probe connected to an electronic amplifier equipped with calibrated meter, loudspeaker, controls and, if desired, with devices for making permanent records, an instrument has been developed for detecting and measuring wear in bearings, gears, spindles or slides. In addition to being usable in preventive maintenance programs, the device is applicable in production testing of parts and components by showing fluctuations from predetermined acceptable readings.

It operates on the principle that disturbances caused by parts malfunctioning are reflected as noise energy in the supporting bearings. The highly directional probe picks up this transient energy output or friction loss from the relative movements of contacting parts. The noise energy, and changes therein, are shown visually on a meter calibrated from 0 to 100. They are also amplified and fed to a loudspeaker for aural interpretation.

The meter's sensitivity range is adjustable for various energy levels. Direct comparison may be made between readings taken at different times. The instrument covers a broad parts-motion range. It extends from a few inches per minute, on sliding ways and carriages, up to 150,000 rpm for rotating parts. *Sperry Products, Inc.*

Circle 41 on postcard for more data

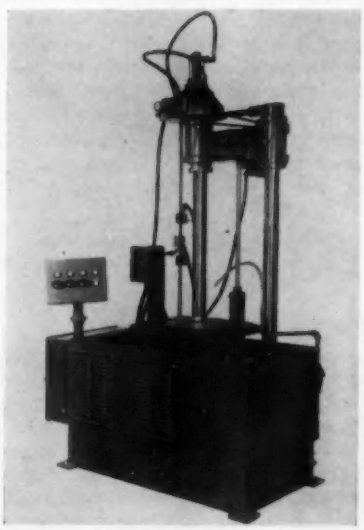
Vertical Honing Machine

A VERTICAL-TYPE production honing machine with capacity up to 4-in. diam and 12-in. height, has been announced. The speed of the V-belt driven spindle is infinitely adjustable from 225 to 550 rpm by means of a knob on the drive head. Adjustable limit switches control and set stroking lengths. Jogging switches on the control panel permit working in any desired section of the part without resetting the limit switches. The honing cycle is controlled by an electronic timer adjustable within a range of 6 to 120 sec.

The ground table is adjustable four ways for squareness. The three-inch ground guide bars are mounted to the fabricated steel base which houses the coolant reservoir, pump and oil filter tray, as well as the hydraulic reservoir and pump. The driving head, mounted to the bars with bronze bushings, is hydraulically-controlled for stroking and constant pressure on the stone expansion. Stone pressure is controlled and set by a regulator valve and pressure dial.

A 440/220/110-v machine tool transformer is provided. Current to all switches and controls, other than the three motors, is 110-v. The machine is 84 in. high, 40 in. wide and 52 in. long. *Superior Hone Corp.*

Circle 42 on postcard for more data



Superior Model VA honing machine

Electronic Indicator

CONSISTING of an adjustable gage head, amplifier and stand, a portable dimensional gage and comparator is said to combine the versatility required for shop inspection and gage room use with ability to measure accurately to millionths of an inch.

The Model IA-515 Indi-Ac electronic indicator features three coded meter scales that facilitate measuring dimensional variations of from 10 millionths to 10 thousandths of an inch. The change from coarse to fine measurements is accomplished by turning the range switch, and the zero points and readings coincide on all scales without separate adjustment for each scale. A centering control permits shifting of the zero electrically to assist setup and provides flexibility in measurements. Minute changes in the gage tip position are electronically magnified up to 10,000 times and read directly on the meter. Gaging pressure is about ¾ oz.

IA-515 Indi-Ac electronic indicator

The instrument can be used for gaging purposes such as surface plate or height work and in checking setups, runout or alignment of part or machine. *Cleveland Instrument Co., Inc.*

Circle 43 on postcard for more data

Spray Gun Receiver

FOR preventing clogging due to paint hardening in the nozzles of spray guns between operating periods, a new spray gun receiver is being offered. It keeps the nozzle tip of the spray gun in a solvent solution, the gun being held securely in the receiver with hoses still attached, ready for use. A reservoir tank, located out of the way of the operator, keeps a constant liquid level in the receiver. A perforated metal fire baffle in the gun port opening is provided for preventing ignition of the solvent in the receiver from exterior sources. Both single gun and multiple gun receivers are available.

Also being offered are paint hose quick-connector receivers. Similar in principle to the spray gun receiver, these are made in various capacities to accommodate different-color-paint hose lines required at the spray booth. They keep the connector ends in solvent to prevent paint hardening at this point when not in use. *The Protectoseal Co.*

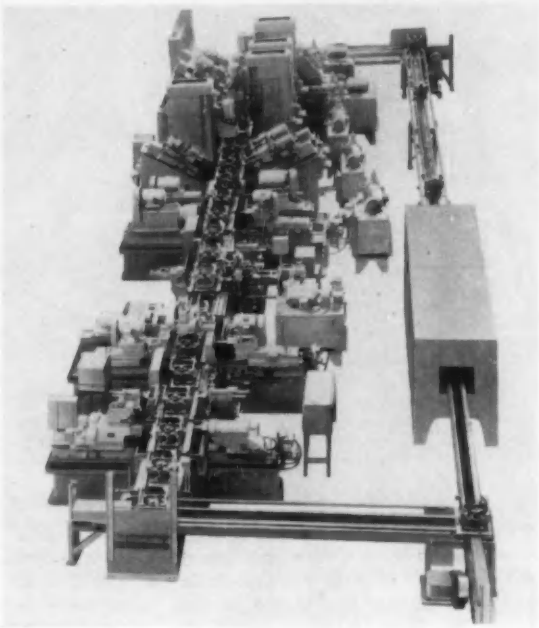
Circle 45 on postcard for more data

Protectoseal spray gun receiver and hose connector receiver (shown in inset) avoid paint hardening between operating cycles

Transfer Machine Processes Transmission Parts

The 25-station Economatic C-4150 pictured completely machines two different automatic transmission extensions. Parts are automatically positioned and clamped in palletized fixtures. Shift from processing one part to another is done quickly through electrical selectors. The machine performs 30 operations, including drilling, tapping, rough and finish boring, automatic assembly of liners, automatic gaging, milling and facing. Rate of production is 180 pieces per hour at 100 per cent efficiency. (Buhr Machine Tool Co.)

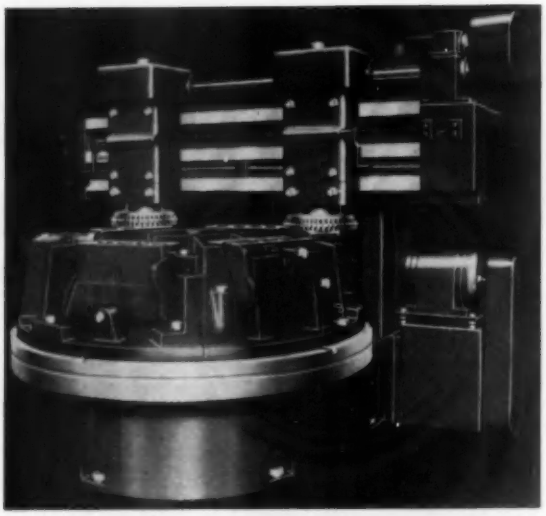
Circle 44 on postcard for more data



Metal Parts Cleaner

Available in two models, the MPC-3 and MPC-4, the unit shown is a pneumatically-operated power agitation cleaner. Fully automatic, it can be used cold or is available with steam, gas or electric heat. Designed for universal application, the cleaner is adaptable for use with all solvents, alkalis and acidic solutions. The machine incorporates combination settings for washings, pre-washing, rinsing and drying. There is a three-way control valve for raising and lowering of the work platform to waist level for easy loading and unloading. (Circo Equipment Co.)

Circle 46 on postcard for more data



This continuous vertical rotary milling machine, the latest addition to the Hamilton Division's Niles line of machine tools, features compactness, high productivity, and rigid construction for accurate milling.

Continuous, Vertical Rotary Milling Machine

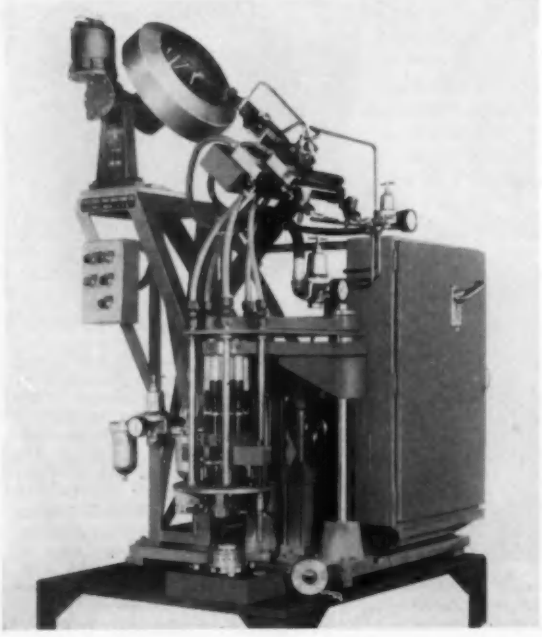
INTENDED primarily for the automotive industry, a continuous, rotary milling machine with circular table and twin spindles is expected to also have application in the aircraft industry, according to the announcement of its development. Of box-type construction, with columns and cross-rail cast integral and bolted to the bed for rigid application of the cutters to the work, the machine is said to permit extremely accurate milling. Compactness and high productivity are also featured.

The work, hand clamped or (with optional equipment) held and released automatically, is fed continuously in multiple setups to the milling cutters. The fixture arrangement allows flexible setups. Finished work can be taken off the table and new work put on while the table is moving and the cutters operating. The spindle heads are independently adjustible vertically and horizontally, enabling the operator in one pass to rough cut with one cutter and, at the same time, finish with the second, or to rough or finish on two levels in two different cutting circles.

Powered with variable-speed drive, the table, which rides on anti-friction bearings, can be set for speeds up to 100 in./hr. Diameter of the table is 72 in. *Hamilton Div., Baldwin-Lima-Hamilton Corp.*

Circle 48 on postcard for more data

Automatic Torque Control Multiple Screw Driver



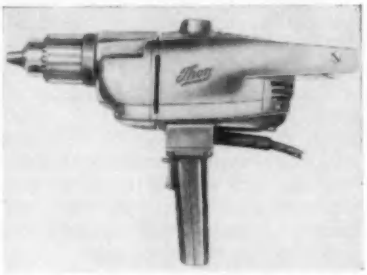
This unit automatically feeds and drives five screws in a transmission stator simultaneously. Mounted on a plate, as part of the stator assembly conveyor line, it is actuated by a limit switch when a stator is brought into place by the conveyor. The head carries five Chicago Pneumatic air drivers with "one-shot" clutch. A spring-loaded auxiliary head, with fingers, forms the lower screw escapement for positioning and holding the screws under the drivers. When the head approaches the workpiece and the air motors are about to engage, the screws are released into their holes. Rate of production is 700 stators per hour (D & L Tool & Machine Co.)

Circle 47 on postcard for more data

Electric Drills

UNIVERSAL electric drills lighter and more powerful are in a new series recently introduced. Made in sizes from ⅝ to 1-in., the Silver Line units in the EN series supersede the company's former UF series. They are shorter, more compact, more streamlined and more efficiently operated. Their motors run cooler than former models.

The EN5, with ⅝-in. drilling capacity, and the EN6, with ¾-in. capacity, come equipped with three-jaw



Thor EN series electric drill

chuck and key. Models EN7 (⅞-in.) and EN8 (1-in.), have Morse taper sockets, which also are available as optional equipment for the EN5 and EN6 models. All four may be ordered with reversing switches in the handles, designated EN5R, EN6R, etc. Equipment includes seven feet of conductor cable with plug, a safety switch handle, a spade handle and a removable dead handle. Feed screws are available as extras.

The EN5 and EN6 have a net weight of 17 and 17¾ lb, respectively, and are a shade over 16 in. long. The EN7-8 both weigh 16 lb and measure slightly more than 18 in. Speeds range from 430 rpm for the smallest model to 300 rpm for the one-inch drill. *Thor Power Tool Co.*

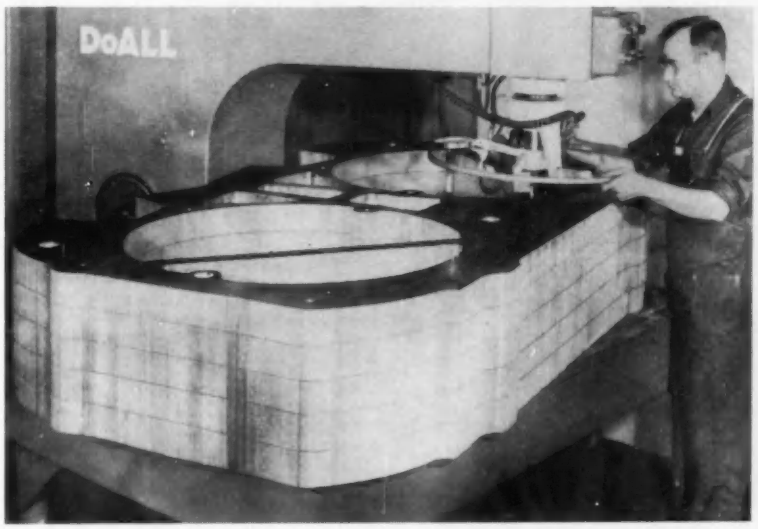
Circle 49 on postcard for more data

Work Is Stationary, Tool Moves with New Contour Machine

OPERATING on the premise that when a workpiece is heavy, ungainly or unbalanced, it is easier to move the tool than to move the work, an articulated band sawing machine has been evolved in which the work is stationary and the cutting head moves. Designated the model 5 contour machine, it has a work capacity of 70 sq ft and is capable of taking a straight cut 14½ ft long. Applications are expected where forming of large intricate contours is required. The production of off-shaped parts by the stack will be another application. The machining of large dies, requiring large capacity and high accuracy, is said to be work for which the machine is ideally suited.

This unit achieves its range and ease of handling by means of an articulated construction. The guiding mechanism is carried by a yoke that houses the parts for the cutting and the power feed. Between the yoke and a stationary member which is fastened to the floor, is an intermediate member. These three members are connected by hinges. This design permits the saw blade to move within a 70 sq ft area.

The yoke houses a four-wheel variable speed band machine, The upper and lower saw blade guides are mounted on tubular posts through which the saw blade travels. Both posts telescope to permit adjustment for work thickness. These posts, together with the power feed wheel, are connected to a countershaft by means of sprockets and chains. Any movement of the top post is thereby transmitted to the bottom post and to the feed wheel. The handwheel connected to the top post permits the operator to twist the saw blade 180 deg in either direction. Turning the handwheel turns the lower feed wheel at the same time the blade is turned. The power feed wheel is a rubber-tired wheel that is driven by motor and causes the entire yoke to move in the direction that the saw blade is pointed. The force of the feed is controlled by rheostat; and the wheel may be raised by means of an air cylinder so that the cutting head may be swung freely when desired. Also included in the yoke are the hydraulic motors driving the two bottom band wheels, etc. *The DoAll Co.*



Stack cutting aluminum plate for air frame part on DoAll Model 5 contour machine. Sawing of a stack of plates weighing 5000 lb or more is said to be practical.

Check 50 on postcard for more data

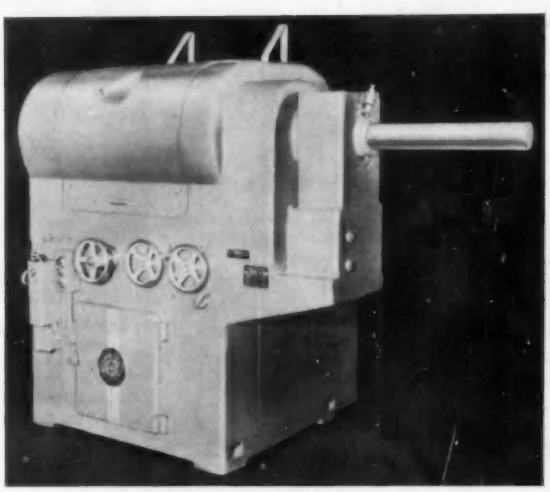
Gear Speeder for Noise-Checking Large Gears

EASIER and truer noise inspection of larger size mating gears is said to be possible with a modified standard gear speeder recently announced. Designated Model 1129-SP, it uses enclosed spindles and a special built-in listening horn for definition of noise characteristics in this particular application. The machine can be provided with fittings for contact microphones and other acoustical equipment.

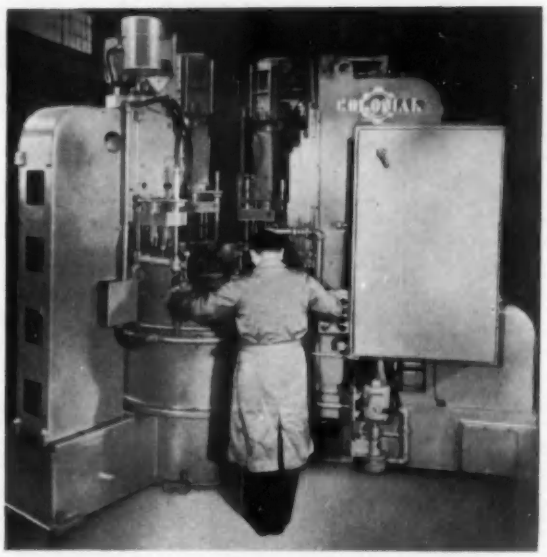
In operation, only one spindle is driven, with brake loads applied to the opposite spindle. The driven spindle is reversible. Control of the gear speeder is by pushbuttons and manually-operated handles. Four spindle speeds (580, 870, 1160 and 1740 rpm) are obtained from a four-speed constant-torque ¾-hp motor. The external contact friction brakes are manually operated and accommodate a variable load.

The speeder will accept gears up to a maximum diameter of 23 in. with a maximum face width of 10 in. Center distance range is 2½ to 12 in. Distance between centers on both front and rear spindles is 25 in. Standard fixtures are provided for gears to be tested. *Michigan Tool Co.*

Check 51 on postcard for more data



Michigan Tool Model 1129-SP gear speeder is a modified standard unit designed for definition of noise characteristics in larger size mating gears. The testing unit uses enclosed spindles and a special built-in listening horn. It will check gears up to 23-in. diam.



Colonial multi-station, multi-operation machine. The six-station tool drills, chamfers, reams, and surface brooches 304 pawls per hour in a cycle time of 12 sec. Combined of standard basic units, its design is felt to be applicable to the production of many other parts

Six-Station Drilling and Broaching Machine

SURFACE broaching is integrated with drilling, reaming and chamfering operations in what is believed to be the first multi-station machine of its type introduced to date. Marking the entry of a company into the multi-operation machine field, the machine performs 14 operations on each of two parts at a time, for an output of 304 pieces per hour at 80 per cent efficiency; cycle time, including loading, being 18 sec. The part in this case is an automotive pawl.

For the pawls, sequence of operations is: load two parts; drill four holes halfway; drill through; chamfer both sides of the holes; ream; broach four surfaces on both parts in one pass; and unload. In operation, blanks are hand-fed, hand-clamped and spring-located in double fixtures on the indexing table. Loading and unloading time is eight seconds. Indexing is hydraulically - actuated through cam-controlled limit switches, which also operate the broach return mechanism. Accuracy of index alignment is within 0.0005-in.

The hydraulic system of the broaching station is designed to offer a 40 per cent safety overload margin above machine capacity. Drilling, chamfering and reaming work stations are standard electrically-driven units. All hydraulic and electrical controls are interlocked and installed in accordance with JIC standards. *Colonial Broach and Machine Co.*

Check 54 on postcard for more data

Soft-Material File

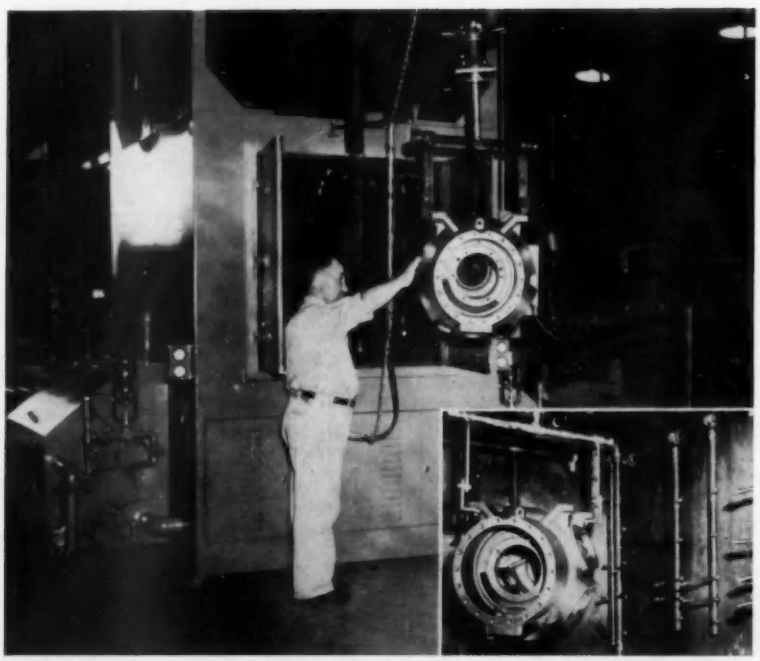
PRIMARILY developed to cut softer metals faster and smoother without chatter or tracking, a new file has found application in smoothing the rough edges of acrylic in the construction of canopies for jet aircraft. Company officials point out that the Whizcut file is different in two ways than other Vixen files. First, the milled-curved teeth are cut off-center to provide a variable degree of tooth angle and spacing from edge to edge on the file face. Second, ground-in chip breaking grooves are added to reduce chip size. These minimize loading when cutting soft metals or acrylic. *Heller Tool Co.*

Check 52 on postcard for more data

Cleaner and Inhibitor

CALLED Antiox Type R, a new type of safety solvent has been developed for cleaning and inhibiting corrosion of ferrous and non-ferrous metals in one operation. It performs a thorough degreasing job, and at the same time deposits a protective coating which guards against corrosion and rust. This protective coating is colorless, non-tacky, and non-toxic. *The Penetone Co.*

Check 53 on postcard for more data



Large Casting Washed Automatically

The washing machine pictured was designed for washing and completely removing metal chips from the machined casting also shown. Part is suspended within the spray chamber by a rotating fixture. In operation, sprays of hot detergent solution play upon the rotating casting from the sides, top and bottom, followed by a rinsing spray, a rust preventive coating, then a steam bath at 300 F to dry the part. Ten castings per hour are processed. (Industrial Washing Machine Corp.)

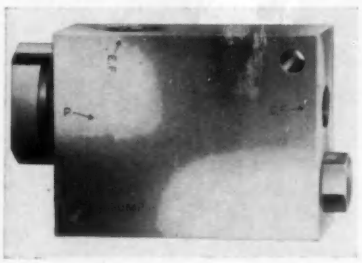
Check 55 on postcard for more data

NEW PRODUCTS
AUTOMOTIVE-AVIATION

FOR ADDITIONAL INFORMATION, please use reply card on PAGE 69

Hydraulic Flow Divider

Permitting two simultaneous operations from one pump, a hydraulic unit recently introduced divides the flow in any desired proportion. It can be adjusted with an ordinary screw-



driver to control the flow over a range from 10 to 95 per cent as the circuit may require. It also has a built-in relief valve that will pass the oil back to the sump when the peak pressure setting of the secondary flow is reached.

The flow divider is so designed that when the pressure of the primary operation begins to build up, the flow to the secondary operation begins to decrease. This means that on a fork truck, for example, no power in lifting will be sacrificed to power steering.

Operation of the device is said to be smooth and quiet, and unaffected by temperature. *New Products Corp.*

Circle 60 on postcard for more data

High-Strength Alloy

Announcement of a new high-strength alloy for jet engine components operating in the 1200 to 1400 F temperature range, was made recently. Designated J1300, it was conceived as a jet engine wheel material. Its strength-to-weight ratio is said to represent an improvement of 25 to 40 per cent. Low content of strategic metals, and a life of 1000 hr or more at 15,000 psi and 1500 F were among the development requirements reportedly achieved.

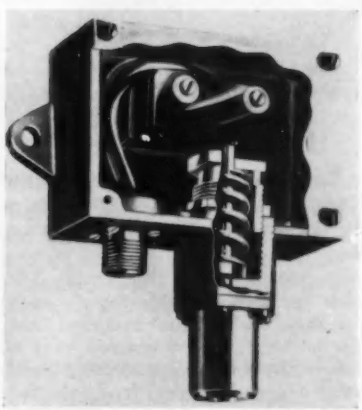
Evaluation tests have shown the alloy to be an excellent high-strength bar and forging material for the medium temperature range, and potentialities as high-strength sheet in the 1200 to 1400 F range. It is indicated that because of its demonstrated workability and formability, plans are now under way to specify the material for critical structural sheet components throughout an entire engine. *General Electric Co.*

Circle 61 on postcard for more data

Pressure Switch

Adjustable over its entire operating range of pressure from 0 to 1200 psi, a hydraulic and pneumatic pressure switch recently announced will reportedly withstand over-pressure as high as 3000 psi without distorting its pressure element. Adjustments can be made simply without interfering with the element.

Made of cast aluminum alloy (stainless steel also available), the unit is totally enclosed and weatherproof. It uses any Micro switch, 15-



amp, 120 to 460-v ac, with single-pole double-throw silver contacts, and is also obtainable for d-c applications. The switch can be arranged for wall or bracket mounting in any position. *Alloy Bellows Engineering Co.*

Circle 62 on postcard for more data

Electric Generators

Entry of a company into the portable electric generator field has been announced with the introduction of two 1500-w models. Featured is a vertical shaft design where the entire

weight of the generator is supported by tubular framework. Since the engine only has to turn the armature, and not support the generator as well, longer life of wearing parts is expected. A further advantage cited by the company for the vertical design is simple shock mounting which isolates vibration of the moving units from the frame. The assembly floats in the framework, which also serves as a protective guard and carrying handle.

Powered by gasoline engines, the two models — EG-1.5A for ac and EG-1.5D for dc — provide 13 amp of 115-v current for operation of electric drills, saws, hammers and other tools. Compact and portable, the generators weigh 95 lb, and are 23¾ in. high by 23 in. diam. Each as a four-stroke, single cylinder, aircooled engine with automatic rewind starter. A toggle type ignition switch is used. Two plug-in outlets are provided, and any number of tools or lights with a total power requirement up to 1500-w may be used simultaneously. *Thor Power Tool Co.*

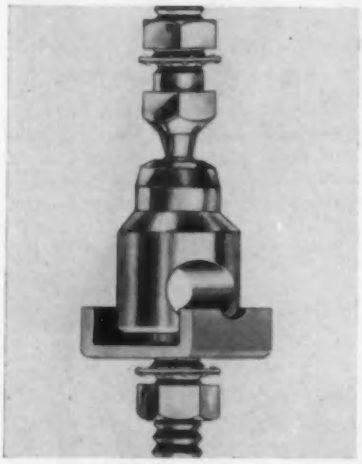
Circle 63 on postcard for more data

(Continued on next page)

NEW PRODUCTS CONTINUED FROM PAGE 67

Ball Joint

The principal feature of an improved design of ball joint is the location of the ball socket in the same unit as the cross-drilled hole, providing added wall thickness. Designated the Type EC ball joint, its design is



said to enable more than 250 lb force to be applied on the unit.

The swivel construction is assembled with a Neoprene washer to cushion movement and maintain tension. A spring clip allows quick adjustment over generous length, eliminating threaded rods and setscrews. Nut, lockwasher and spring clip are permanently assembled on the unit to prevent loss.

Present usage for this ball joint includes automatic transmission, heating, ventilating and air control applications. *J. J. Tourek Mfg. Co.*

Circle 64 on postcard for more data

Aircraft Actuator

Designed to operate within a temperature range from −67 F to +600 F, an all-stainless steel actuator is now being offered for aircraft ap-

plications. The new actuator is hydraulically operated over a range of pressures from 0 to 3000 psi. It can also be adapted to pneumatic operations to meet needs of certain installations.

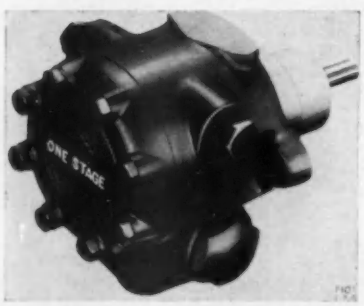
Prototypes, such as the unit illustrated, have a stroke of seven inches. They are 16 in. long and 2⅜-in. diam. The basic design can, however, be altered to suit specific performance and space envelope requirements. High temperature seals are incorporated. *Aircraft Div., Ex-Cell-O Corp.*

Circle 65 on postcard for more data

Oil Pumps

Designed to handle lubricating, hydraulic and light fuel oils at pressures up to 300 psi and speeds to 1800 rpm, a new line of pumps are obtainable as standard units or can be engineered into existing or new equipment. Where higher speeds, up to 3600 rpm, are needed, modified versions with special gearing are available. Pumping capacity of the Model OB pumps is 24, 30 or 39 gph, with right or left rotation versions obtainable. Either two-bolt integral mounting or bracket-type mounting may be used.

Quiet operation, long life and efficiency are said to be assured by the Rota-Roll gears utilized. The tooth form of the pumping elements reduces friction and provides a pumping action that produces a vacuum



of 20 to 25 in. mercury max. A lapped Nitroloy seal, flexibly held against a dry lubricated bronze bushing clamped to the shaft, is used to prevent leakage along the shaft. The seal chamber is subjected to inlet pressure only. The hardened and ground shaft has a bearing that is continually lubricated by the liquid being pumped. Pulley drive, as well as direct coupling, is possible. The pump has two inlet and two outlet ports that permit connections on either side of the body. Unused ports can be used for pressure and vacuum gages. *Sundstrand Hydraulic Div., Sundstrand Machine Tool Co.*

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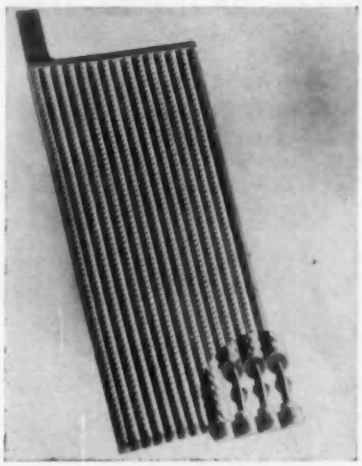
Improved Battery

Incorporating a new type of armored porous tubing to encase the grid spines and active material of the positive plates, a battery development just announced offers increased capacity for electric industrial truck



applications. Called the TG Exide-Ironclad model, it has a rated capacity of 72 amp-hr per positive plate. This is in contrast with the 50 amp-hr rating of the TLM of 3½ years ago, and the 60 amp-hr rating of the more modern TH.

The greater battery capacity can be used for added productivity of existing trucks, or may permit the use of smaller, more maneuverable trucks with the same power. For example, a truck now using an 18-cell, 36-v, 720 amp-hr battery with 25 plates per cell, can be equipped with a new 25-plate TG having a capacity of 864 amp-hr. Or, it can be equipped with a new 21-plate TG, rated at the same 720 amp-hr. The 21-plate TG saves 4½ in. width, as against the former 25-plate battery.

Key to the added capacity is the armored porous tubing surrounding the tubular-type plate design. The tubing is highly permeable to the diffusion of electrolyte and the passing of current, while eliminating practically all shedding of active material. This, in turn, allows more efficient utilization of the space within the battery.

The TG series is available in 11 sizes, with from 11 to 33 plates and in capacities ranging from 360 to 1152 amp-hr at the six-hour discharge rate. *The Electric Storage Battery Co.*

Circle 67 on postcard for more data

Free INFORMATION SERVICE

Use either of these postcards for Free Literature listed below, or for more information on New Production Equipment and New Products described in this issue.

USE THIS POSTCARD

FREE LITERATURE

Deep Hole Drills 1

Data sheets and application information on deep hole drills of inserted carbide, solid carbide, and high-speed steel are contained in a file-type folder available from *The High Standard Mfg. Corp.*

Tube Fittings 2

Catalog 4310, 52 pages, presents full data on the Triple-Lok line of tube fittings, made in brass, steel, stainless steel, and aluminum. *Tube & Hose Fittings Div., Parker Appliance Co.*

Automatic Chucker 3

Design features and specifications of a single spindle chucking machine for automatic machining of large workpieces are presented in Bulletin 5613, four pages, issued by *Warner & Swasey Co.*

Fume Collectors 4

A bulletin on preventing atmospheric pollution caused by fumes from electric steel melting furnaces includes a discussion of cloth filtration for cleaning furnace ventilating air. *Wheelabrator Corp.*

Hardness Tester 5

Bulletin 52, four pages, describes an air-operated Brinell hardness tester and includes complete specifications for the two available models. *Tinius Olsen Testing Machine Co.*

Die-Casting Machines 6

Four models of universal high-pressure hydraulic die-casting machines, 50 to 600 tons, are presented in an eight-page bulletin made available by *Cleveland Automatic Machine Co.*

Plastics Filler 7

Bulletin Lu-12, four pages, discusses the uses of molybdenum disulfide as a filler in nylon, phenolic laminates, Teflon and other plastics, natural and synthetic rubber, and asbestos. *Climax Molybdenum Co.*

Grinder Parts 8

Catalog G-678, 30 pages, contains data on work blades and guides for a line of centerless grinding and lapping machines. *Cincinnati Milling Machine Co.*

Punch Presses 9

Turret punch presses for piercing sheet metal and plate in short to medium production quantities are described in Bulletin 201, four pages, issued by *Wiedemann Machine Co.*

Air Compressors 10

A 20-page catalog lists a line of ½ to 20-hp air compressors for automotive and industrial use. Included are specifications for single and two-stage models, portable models, tanks, pumps, and accessories. *Kellogg Div., American Brake Shoe Co.*

(Please turn page)

VOID After May 1, 1957 3/1/57

Circle code numbers below for Free Literature, New Plant Equipment, or New Product Information

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FREE LITERATURE—*Continued*

Electronic Wire 11

Four-page folder 19-586, on high-temperature electronic wire designed for the internal wiring of electrical and electronic equipment, meters, and panels, has been issued by *General Electric Co., Wire and Cable Dept.*

Cold Forging 12

A process for cold forging super alloys into virtually any shape, that has been used with S-816, Iconel 700 and 713, Udimet 500 and A-286, is briefly described and illustrated in a four-page brochure isued by *Impact Products, Inc.*

Epoxy Resin Systems 13

A summary chart listing the physical and electrical properties of 25 different epoxy resin systems has been made available by *Permacel Tape Corp.*

Slitters 14

A 76-page, illustrated handbook provides details on slitting lines for coil and sheet, including coil handling, scrap disposal methods, and other operating data. *Yoder Co.*

Hydraulic Equipment 15

Industrial fluid power equipment is covered in Bulletin 400, which includes information on gear-type and dual-vane hydraulic pumps, control valves, and cylinders. *Kalamazoo Div., New York Air Brake Co.*

Zinc Plating 16

Technical Bulletin ZP-ZB-57, 10 pages, describes an entirely new zinc plating process for ferrous materials. *The Udylite Corp.*

USE THIS POST CARD

AI Index 17, 18

Check 17 on postcard for index to Vol. 115 (July 1 to Dec. 15, 1956) of AUTOMOTIVE INDUSTRIES. A limited number of copies of the index to Vol. 114 (Jan. 1 to June 15, 1956) are also available. Check 18 if you wish this index also. *Automotive Industries.*

Lubricators, Sprayers 19

Catalog 403, 32 pages, features automatic and air-powered industrial lubricating equipment, paint and mastic spray units, and accessories. *Gray Co., Inc.*

Vacuum Chambers 20

A 20-page technical bulletin describing "packaged" vacuum chambers designed for controlled-atmosphere welding and metallurgical research, has been issued by *Leader Welding & Mfg. Co.*

Testing Equipment 21

Various types of environment-simulation test equipment are described in a four-page brochure made available by *Mantec, Inc.*

Electric Motors 22

An application guide that facilitates selection of electric motors for popular applications is featured in a 12-page bulletin issued by *Century Electric Co.*

Filter 23

Catalog LFC, 16 pages, gives engineering data on a new all-metal liquid filter, in sizes of 1.7 to 720 gpm, for full-flow filtration of lubricating, hydraulic, and fuel oils. *Air-Maze Corp.*

Carbide Dies 24

Bulletin 356, eight pages, contains details on carbide die sharpening procedures. *Oberg Manufacturing Co., Inc.*

Aircraft Equipment 25

"Profiles in Progress," a 20-page illustrated booklet, discusses aircraft air conditioning systems, turbine engine starters, hydraulic pumps, pneumatic valves, and electronic temperature controls. *Hamilton Standard Div., United Aircraft Corp.*

Tube Notcher

A high-production machine that notches tube or pipe to make fitted joints for welding, is covered in a 24-page bulletin. Address request on company letterhead to *Wallace Supplies Mfg. Co., 1304 Diversey Parkway, Chicago 14, Ill.*

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METALS

Less Pressure on Steel Industry as Excellent Demand Continues. Stockpiling Supports Zinc. Extruded Aluminum Prices Are Down

By William F. Boericke

No Sharp Decline Ahead In Steel Demand

Pessimistic forecasts of a decline in steel demand and rumors that a substantial drop in operating rate for the mills was imminent were heard in February, no doubt sparked by the drastic shakeout on Wall Street during the month. There appears to be no basis for such beliefs. All reports from responsible sources indicate that no sharp decline is ahead.

This is not to deny that certain segments of the steel industry are no longer under the terrific pressure that characterized the final quarter of 1956. Unquestionably flat rolled products are in easier supply and a slight decline in backlogs of orders for such products is recognized. Orders of steel from Detroit have been frankly disappointing to mid-February. But this only reflects the new policy of the automobile manufacturers to keep their steel inventories at a reasonable level and gear them to production schedules. For most mills incoming business still accounts for 90-100 per cent of shipments.

Steel Executives Optimistic

It is emphasized by executives for the major steel companies that present business is very good. Inland Steel reports 100 per cent operations for the first quarter, with second quarter business near the same figure. An official of U. S. Steel believes the second quarter will be a very good one both for his own company and the steel industry. He conceded there has been some inventory building by consumers since the end of the strike which has resulted in bringing them to normal size for a number of products, but added that a normal inventory today may not be normal tomorrow. An economist for Lukens Steel predicts that demand for finished steel in 1957 would be about five per cent greater than last year, and asserted the industry can expect to operate at an average of 88 to 90 per cent of capacity for the year.

This is quite in line with the forecast made recently by IRON AGE—first quarter, 96 per cent of capacity; second quarter, 90 per cent or better; third quarter, 80-84 per cent (usual summer decline); fourth quarter, 88-90 per cent. Overall for the year, 88-90 per cent.

Heavy Steel Products in High Demand

Again it must be repeated that any slackening in demand has been confined to flat rolled products and not to heavy plates, structural, and tubular goods, which remain in tight supply. Plate users, however, are getting some relief because some mills are shifting over from sheet and strip to light plate. And this in turn permits producers of heavy plate to concentrate on the latter so badly needed for the tanker, bridge building and freight car programs.

Pressure continues unabated for higher prices for steel products. It has been sorrowfully remarked that the industry was unanimous for an across-the-board increase except for U. S. Steel. But the latter raised prices about 3½ per cent on various types of pipe as well as extra charges on cold finished bars, rod, and wire. These increases were followed almost immediately by other producers.

It is universally expected that base prices will advance in July following the wage increase that then goes into effect automatically. While there may be considerable opposition because such action would contribute to the inflationary spiral now under attack, it can hardly be avoided. Anticipating this increase it appears likely that inventories will be rather sharply increased in late spring while prices are still pegged to a lower level.

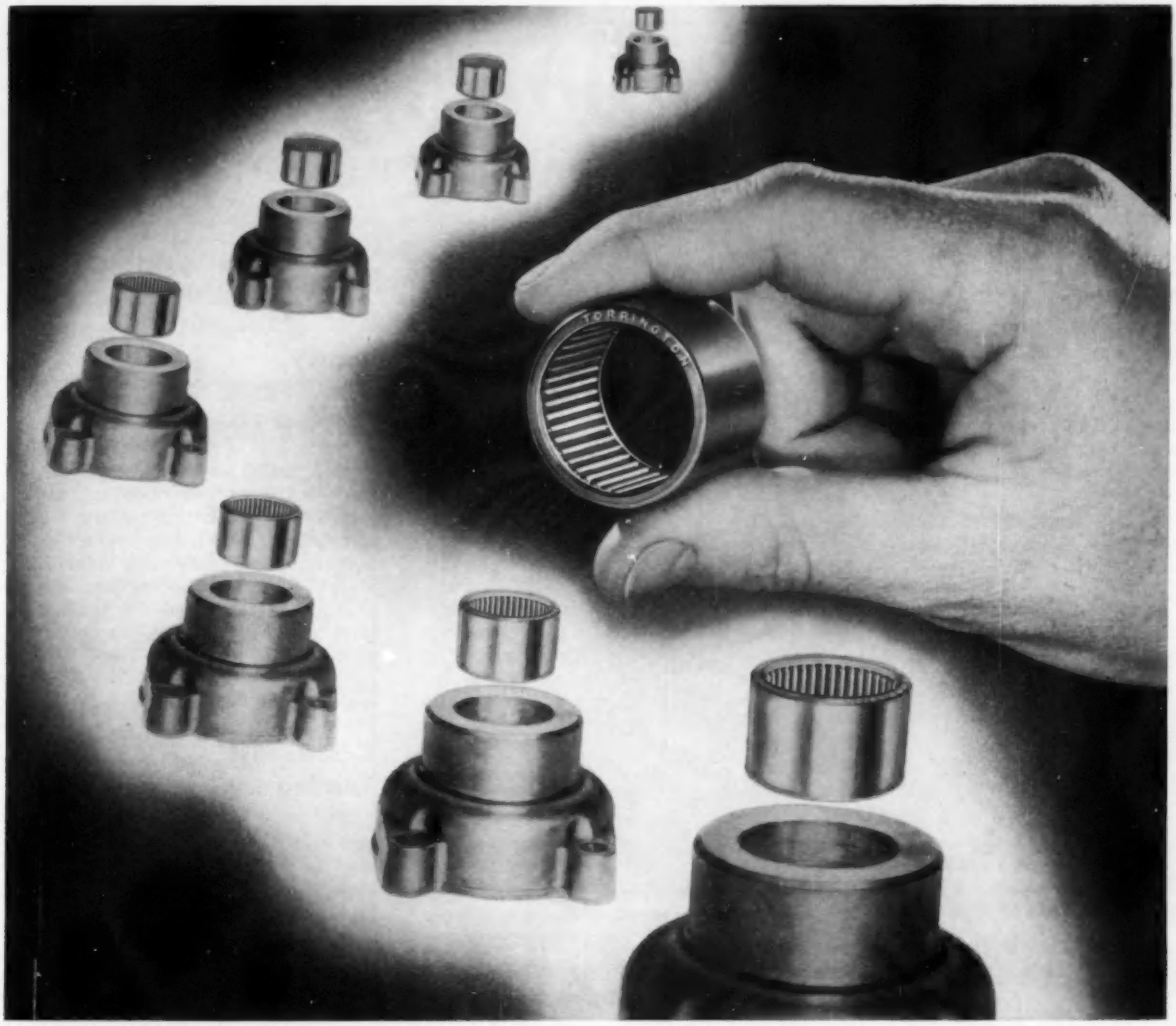
Scrap Prices Slump

The market for steel scrap has reacted violently from its record high of 1956 and the price has dropped $10-15 per ton to $55 in important consuming areas. The mills apparently are adjusting their scrap inventories to anticipate lower operating schedules. However, lower scrap prices increase profit margins for the steel producers if production rate remains the same, particularly for plants with electric furnaces dependent on scrap for furnace feed. Yet the export demand for heavy melting scrap to Japan and Europe is so strong as to cause some concern to the Commerce Department.

Copper Price Slumps

Within two weeks after cutting the copper price from 36 cents to 34 cents a pound, Phelps Dodge Corp., one of the Big Three producers, took the initiative again in slashing the price to 32 cents. Other producers are expected to follow suit. This brought the price to the same level as was set by the custom smelters in mid-February. On the London Metal Exchange copper sold at 30½ cents. The Rhodesian

(*Turn to page 74, please*)



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Observations

By Joseph Geschelin

Sealed System

Talk of a sealed liquid cooling system is being revived in certain quarters. It contemplates use of a special type of fluid not available heretofore. One of the chief drawbacks in the past has been that many people doubted whether a sealed system would be reliable. Apparently the synthetic materials available today give more assurance of longevity so essential to a sealed system.

Suspension Progress

It is hinted that by 1958 model time there will be one or more additional makes or models equipped with air spring suspension. Just as in the case of the original Packard torsion bar suspension, air ride requires a positive means of levelizing. Cadillac employs a small electric motor driven compressor for this purpose. And it is not a power robbing arrangement as some think since the small motor is not running continuously. We understand there is an alternate design in which air bled from the cushions is directed into a reservoir, thus constituting a closed system. Whether or not the complication of plumbing and reservoir is practical and economical is something that will have to be explored.

Quality Control

We mentioned some months ago that most car producers initiated a crash program of quality control in advance of 1957 models. It was imperative in view of the problems facing car buyers in breaking in new purchases. We wonder how well this has turned out considering the reports we get of customer dissatisfaction. One big problem this year has been with sheet metal fits on some cars. Door fits, hood fits, and deck lid fits have been quite poor. This has more to do with press die design and try-out than anything else. It is something that has to be remedied quickly.

Safety Belts

A recent article on the subject of safety belts, implying that in their present state of development it is safer to be without, spurred some heated discussion in private correspondence. According to Cornell workers recent work with seat belts reveals that they provide more than a 40 per cent improvement in safety. With seat belts the magnitude of a blow on the head is reduced about ¼ to 1/3 of the intensity without seat belts.

Crankshaft Turning

We hear that a new type of crankshaft lathe is in the offing and may be announced later this year. Main feature is high cutting speed to facilitate the use of carbide tools.

METALS

Selective Trust had previously cut it to 31¼ cents.

The action by Phelps Dodge violated precedent in that heretofore the policy of the major producers has been to avoid rapid price changes for the red metal. The previous 36-cent price had held since October last year.

However, it is now abundantly clear that the first cut to 34 cents did little to attract buyers. No influx of orders followed. The brass fabricators were down to a four-day week with no indication of interest from Detroit. Wire and cable business held up better but competition was severe, with building wire slow because of the drop in housing starts. Competition was especially keen from abroad with substantial price cuts in rolled copper products made possible by lower prices for the metal in foreign markets and a slowing down in industry because of the Suez crisis.

In short, there was definite lack of confidence in the copper price, and consumers, sure of adequate supplies,

(*Continued from page* 72)

merely ordered from hand to mouth. Published figures, given wide publicity, reflected that U. S. supplies of copper, including imports, exceeded shipments by 15-20,000 tons a month. A market of 30-32 cents a pound was anticipated, at which it was thought some real buying interest would be encountered.

Not the least factor was announcement that the Denver Mint had bought 400 tons of copper at 31.79 cents a pound at the very time that the major producers were quoting tenaciously 34 cents. The new cut to 32 cents followed on the heels of this news.

January Figures Show Improvement

The January figures for the Copper Institute gave some slight cheer, however. They showed a good pickup in deliveries to the fabricators, rising from 99,600 tons in December to nearly 120,000 tons in January. At the same time refined stocks of copper were reduced slightly from the year end total. Until some confirmation is received from the fabricators themselves that their shipments to consumers have shown a like trend some skepticism on actual improvement is bound to continue.

It is possible that Washington might begin to buy copper for the stockpile just as it has done for lead and zinc. If the price falls to 30-31 cents, some producers might put copper to the Government as they have the right to do under contracts made to encourage output when copper was in short supply. And finally, the current lower price rather definitely lessens the danger of loss of market to competitive metal that existed when the copper price was in the stratosphere.

(*Turn to page* 92, *please*)

Using DU PONT ELASTOMERS

NEOPRENE • HYPALON

in Design

HYPALON® solves some heat and ozone problems for resilient materials

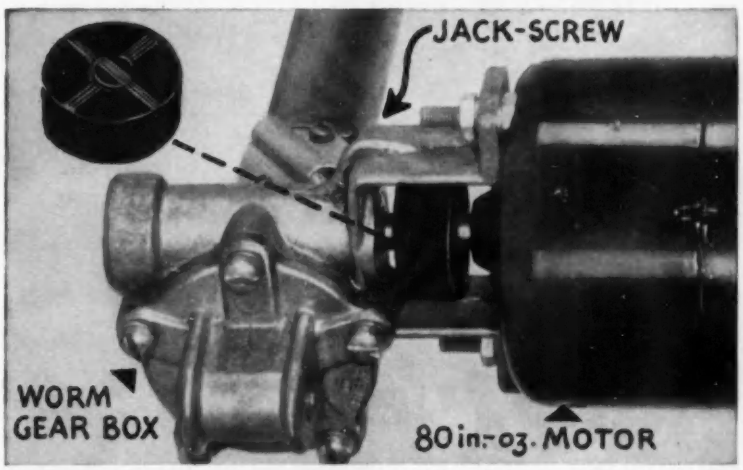
HYPALON is completely unaffected by ozone, and, when it is compared with other kinds of rubber, it also shows unusual resistance to hardening at elevated temperatures (250°-350°F.). These two facts offer new opportunities to design engineers who are faced with the problem of using resilient materials in today's high-powered engines.

Already HYPALON is being used in molded spark-plug boots (see photo below) and ignition cable jacketing. In these applications, HYPALON's superior resistance to heat, plus the fact that it is completely unaffected by ozone, makes it a logical choice. HYPALON is the most economical choice in the long run, too, because it gives an extra-long service life to any product exposed to heat and ozone.

HYPALON has many other uses in the automotive industry. It's being used as a protective coating on rubber door stripping for automobiles because it protects against deterioration by sunlight and weathering. Durable HYPALON also can be compounded in an unlimited range of *light-fast* colors to blend with the modern fabrics and exterior paint colors of today's cars. These are just a few examples. For further information on HYPALON, just mail the coupon.

MOLDED spark-plug boots of HYPALON withstand high temperatures, are unaffected by ozone.

NEOPRENE flexible couplings in seat adjustor last well over 30,000 cycles



FRONT-SEAT ADJUSTOR propels seat with force of 1,200 lbs. Jackscrew is driven by 80 inch-ounce motor through neoprene coupling and worm gear.

Neoprene chosen for resilience, resistance to oil

The auto company that uses this seat adjustor has a test requirement of 30,000 cycles, operating a standard seat loaded with 450 lbs. When the unit was first designed, the manufacturer used a barrel spring for the coupling. It proved to be too noisy and barely lasted through 10,000 cycles before it failed.

The solution to the problem was the flexible coupling shown above. It consists of two flat metal inserts molded into a neoprene disk. One insert engages the worm shaft; the other engages a slot in the end of the motor shaft. Neoprene was chosen as the elastomer for the coupling because its resilience assured a quiet operation of the adjustor, and its superior oil resistance guaranteed long life to the coupling. The coupling is subjected to occasional contact with oil coming from the worm shaft.

NEOPRENE couplings outlast metal seat

The auto company's test engineer says he can't recall a neoprene coupling ever failing to pass 30,000 cycles. "In fact," he says, "in tests run to destruction, the coupling was still going strong when the seat itself was completely shot!"

This is just one example of neoprene's proven performance. Its resistance to oil, heat, weather and sunlight has led to its use in many other automotive applications. For more information on design problems solved through the use of neoprene, mail the coupon below.

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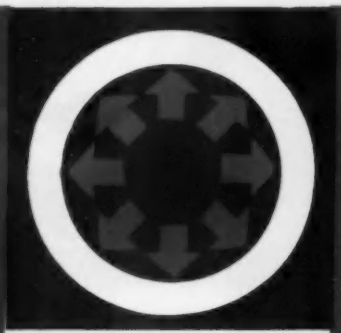
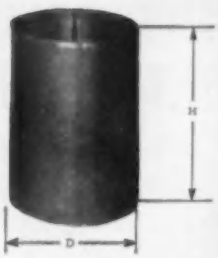


GROTNES EXPANSION FORMING SHAPED THIS PART—

how would YOU do it?



BEFORE EXPANDING—Deep Drawing Quality Steel 0.035" Thick is Coiled and Lap-Seam Welded to form the 9⅜" I.D., 12¼" High Cylinder Blank.

FIRST EXPANSION—Opens one end to 12½" dia.; Expands the other end to 10" dia.; reduces height to 11⅝"

SECOND EXPANSION—Forms the bead; opens the large end to 15" dia.; leaves the small end at 10" dia.; reduces height to 11⅛"; reduces metal thickness to .031" at the large end.

After trimming the protrusion at the weld, the part is ready for subsequent operations. Success in expansion forming this part, as well as any other, depends on metal ductility and weld strength.

Expansion forming and sizing the connector illustrated results in smaller tooling investment, lower material cost, less scrap, fewer operations, higher production.

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Milling Machine

(*Continued from page* 28)

neath floor level. The sub-floor area is 25 by 25 ft high and contains a smaller pit 8 ft deep and 6 ft in diam. The small pit accommodates the mechanism for the turntable on which the workpiece rides. The machine rises 17 ft above the floor of the Ames Laboratory machine shop, and occupies an area of more than 600 sq ft.

The machine is equipped with 17 electric motors having a total horsepower of 424. Two spindle motors, each with 75 hp, drive the metal-cutting tools. Other motors turn the table on which the pattern is mounted, provide lubrication, pressurize the complex hydraulic system, and furnish cooling where necessary.

A wide range of flexibility has been built into the machine, so that it can work in various materials. For cutting alloy steels, for example, a speed range of 78 to 785 ft per minute is available; for aluminum alloy, speeds between 314 and 3140 ft per minute are available. The Danly unit is capable of working to an accuracy of plus or minus 0.004 in. over a chordal length of 24 in., while maintaining a good quality of finish.

The machine has been used to produce models for testing in supersonic wind tunnels at Ames Laboratory and to mill a series of blades now installed in the main drive compressors of the wind tunnels themselves.

Tire Cord

(*Continued from page* 43)

Nylon tires had fewer failures except from human error—repair failure or tire run until it was completely worn out. Refer to table of failures for causes.

If all nylon tires had been used in the test, an average saving of at least $29.42 per cab per year would have been realized as compared with rayon tires.

The degree of difference between nylon and rayon tires will vary for different cars and fleet operations. Such items as tire size, car weight, road surface, road conditions, driving speed, new tire and retreading costs would naturally vary the results of the du Pont test.

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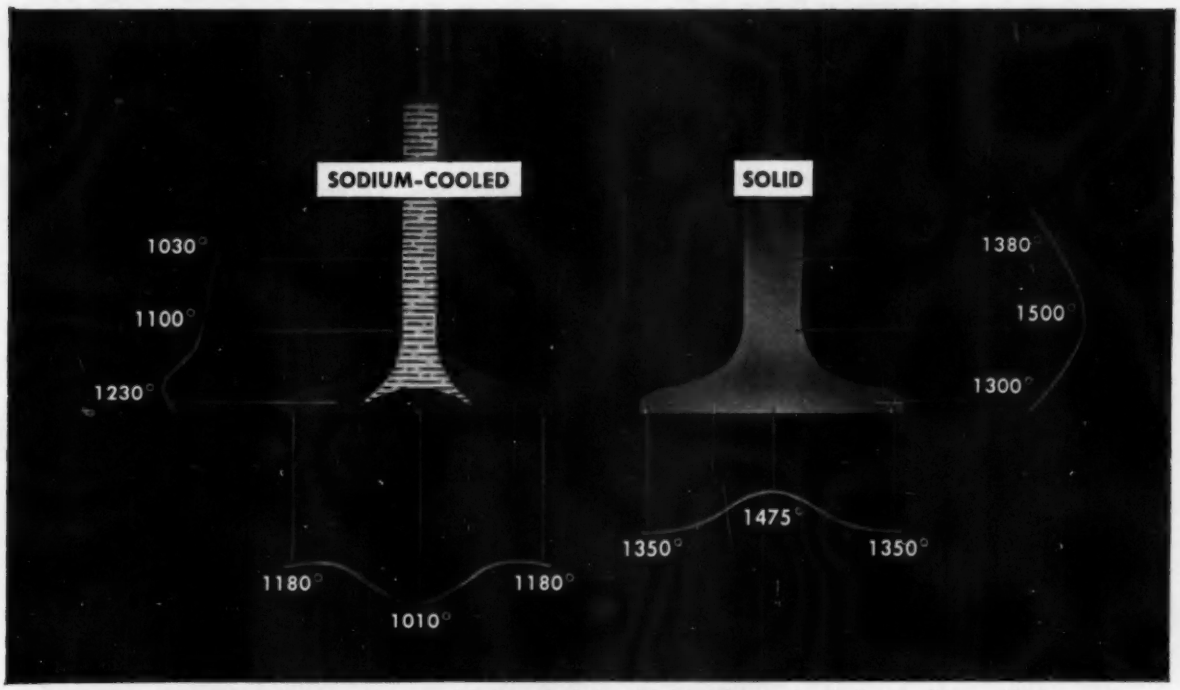
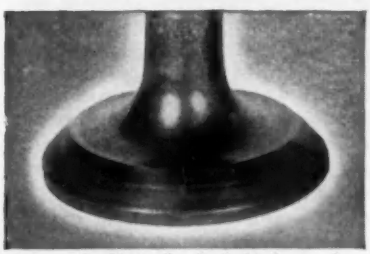
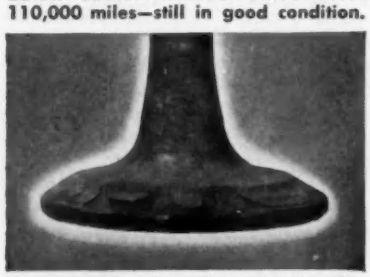
Eaton Sodium-Cooled Valves Run Cooler—



These curves show operating temperatures of Sodium-Cooled and Solid Valves under similar conditions of high output.



Eaton Sodium-Cooled Valve after 110,000 miles—still in good condition.



Conventional valve after 35,000 miles in same type of operation as Sodium-Cooled Valve shown above.

Cooler Valves Last Longer

Today's trend in engine design toward higher speeds and more economical fuel-air ratios results in higher temperatures for many operating parts—including exhaust valves. These higher temperatures sharply reduce valve resistance to corrosion and distortion, definitely limiting valve life. Eaton Sodium-Cooled Valves, operating at considerably lower temperatures, maintain corrosion resistance and strength.

In general, maintenance of Eaton Sodium-Cooled Valves in heavy-duty truck engines is scheduled only at time of major engine overhaul. No in-between trips to the shop are necessary for valve servicing. Engine output is maintained at high levels over long mileages. In many millions of miles of heavy-duty operation, Eaton Sodium-Cooled Valves have proven their ability to keep trucks on the road and out of the shop.

Eaton engineers will be glad to work with you in applying the benefits of Sodium-Cooled Valves to your engines.

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SPI Conference

(*Continued from page* 37)

Postforming Rigid Urethane Foam Core Material for Repairs and Manufacture of Aircraft Sandwich Structures

By Howard R. Moore, U.S. Naval Air Development Center

FOR repair of radomes, a postforming technique was developed to shape the urethane foam, and this was compared to the foamed-in-place techniques used. When repairs were attempted by foaming new resin in place, the new material was weak, due to the impracticability of curing at 250-275 F. The new material was also of greater density than the original, and nonuniform, making it electrically unusable.

By heating prefoamed rigid urethane slabs ¼ to ½ in. thick to above 275 F, it was found possible to form them to the surface contour over which they were bent. Preheating the mandrels used in forming to 125-140 F helped reduce the sudden chilling of the slab. The slab was then heated in an oven at 300 F for a time dependent upon thickness, and formed over the mandrel. The forming should take place within five seconds of the time of its removal from the oven. Forming pressure should be continued during cooling. The postformed urethane can then be machined or otherwise finished to size for the repair.

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This king pin is truly king-size: 8" long and weighs about 12 lbs. We machined it out of No. 3140-2⅞" bar steel. After heat treating, bearing surface was given the specified fine finish-grind to 2½" dia., +.000 —.001.

Parts like this are our specialty —we've been making them exclusively for the automobile industry for more than 40 years. Each year has added to our knowledge and skill in precise machining, scientifically-controlled heat treating and micro-finish grinding. Let us show you what we can do with one of your tough jobs. Write or wire.

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Design and Fabrication of Heat Resistant Radomes

By Hugh O. Pierson, Goodyear Aircraft Corp.

HEATING due to air friction at supersonic speeds is probably the most formidable barrier ever met in aviation history, and heat resistance becomes a major factor in aircraft and missile design. This is true in radomes, which are now sometimes a part of the primary structure of the plane. The materials available: 1) Modified polyesters. With proper postcure, they retain good structural properties up to about 360 F, where strength drops off rapidly. They are of little value above 400 F. 2) Triallyl cyanurate. Strength retention to 500 F is good, but the polymerization reaction is very violent and fabrication tricky. 3) Epoxies. New formulations show excellent strength retention even after 200 hr at 500 F. Electrical properties are now much improved. This work is still experimental, however. 4) Phenolics. Some of the newer low pressure phenolics appear to be promising radome material. They have poor resistance to thermal shock, however. Modifications in the cure cycle may improve them. They show excellent strength retention to about 750 F, and for short periods at even higher temperatures. They do not have good electrical properties. 5) Silicones. These materials have good heat resistance in the 750-100 F range, have good electrical properties, but their room temperature strength is low. 6) Isocyanate foams and honeycomb. The materials now in use barely reach 250 F. Better materials are in sight, but are still in development. 7) Reinforcements. Glass be-

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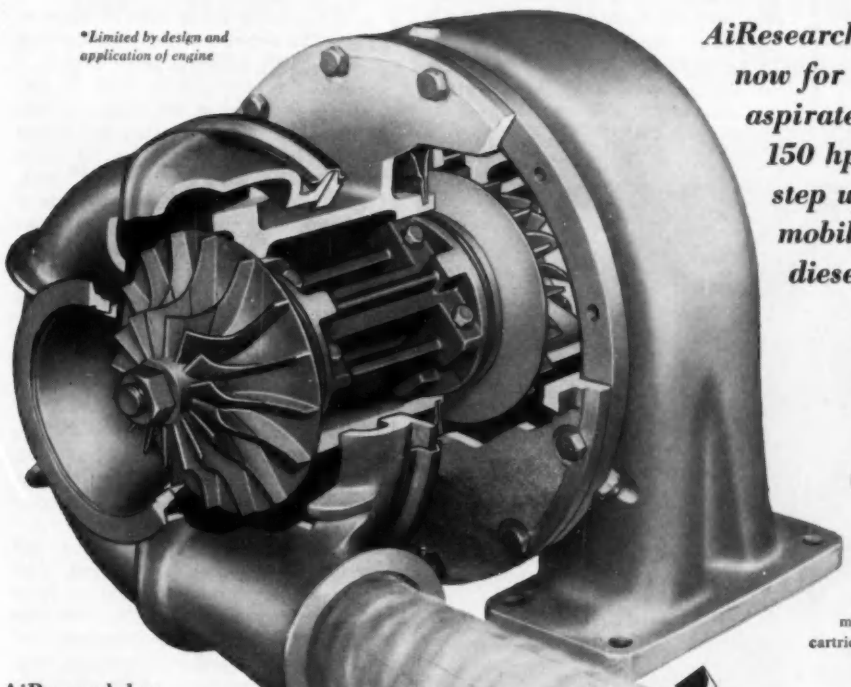
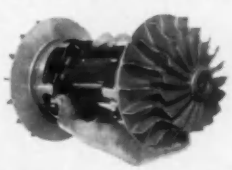


AiResearch units are available now for use with normally aspirated diesel engines of 150 hp and up. They step up performance of both mobile and stationary diesels, land or marine.



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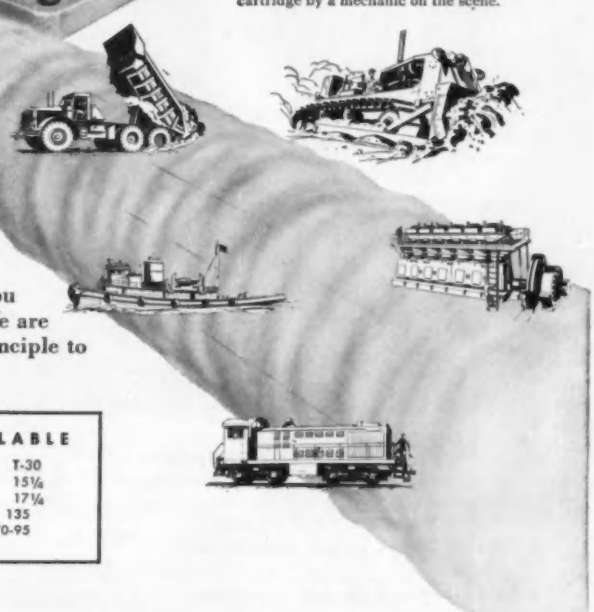

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MODEL	T-10	T-15	T-16	T-30
Diameter — in. nom.	9	15¼	11½	15¼
Length — in.	9	16¾	15¾	17¼
Weight — lb.	39	125	100	135
Output — lb/min. (Standard Conditions)	25-40	35-65	45-65	70-95

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gins to soften at about 1200 F, and is of little use above that temperature. Asbestos, while of similar physical properties to glass, retains its integrity at higher temperatures. 8) Inorganics. Such materials as ceramics, and especially aluminum oxide, show promise for radomes. Sodium silicate coatings over organic laminates may provide some answers. All are still in early development stage.

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Bearings for Aircraft

(*Continued from page* 41)

A design objective is to be able to build a self-contained rotating assembly containing the necessary lubricant, seals and bearings for high speed, high temperature operation. Such a package can be manufactured for refrigeration turbine installations and other turbo-accessory equipment.

A "Turbo Cartridge" mounting embodying several of these features is currently under development.

A typical bearing mounting for the power turbine of an alternator drive is shown in Fig. 2.

The reversible type of mounting with maximum capacity bearings is shown together with an outer ring riding pressed metal type of separator. The entire cavities surrounding the bearings are filled with grease.

While a very simple type of closure is provided at the output pinion end, it becomes necessary to design a more complicated seal in the drive turbine end of this high speed shaft. The turbine end seal incorporates a plenum chamber connected to by-pass vents which serve to by-pass any hot leakage gases and prevent them from getting into the bearing housing.

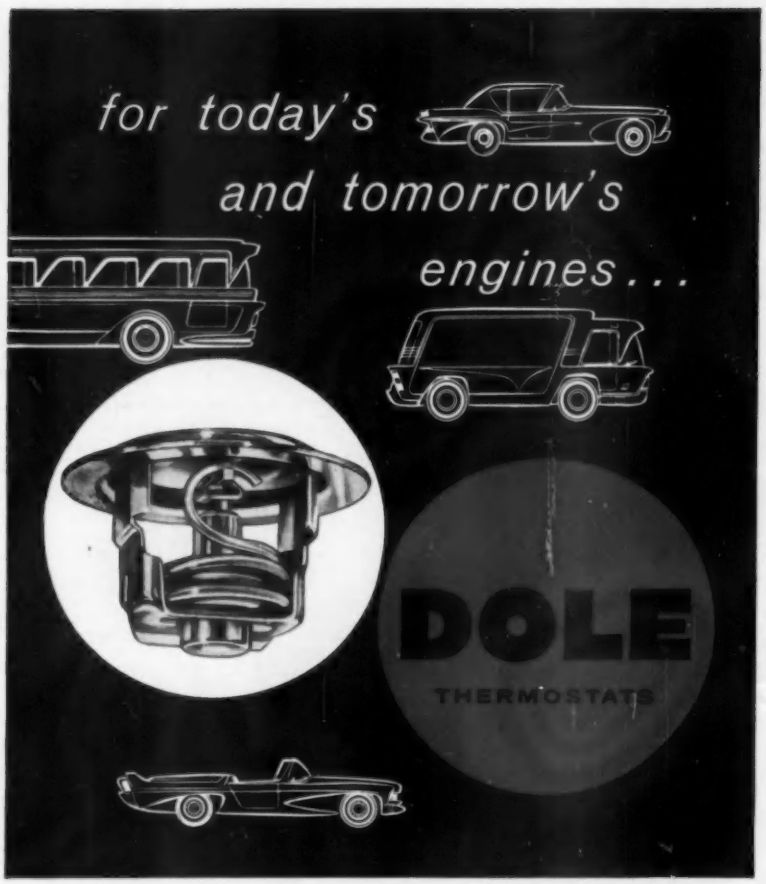
Bearings have been furnished for this type of unit which have operated successfully with grease lubrication at DN values in excess of 500,000 for periods as long as 500 hr.

Figure 3 shows a bearing mounting design for a high temperature fuel pump installation where comparatively short life is required.

Reversing type of mounting and wick oil lubrication is employed. Two spring preloaded wicks feed oil from the annulus surrounding the housing to the bearings. The uniqueness of this application is only in the very high temperature at which this unit has to operate for a short period of time. The comparatively cooler fuel being pumped is used to jacket the lubricant and protect it from the very high ambient temperatures which were believed to be in the neighborhood of 900 F.

A turbine driven air compressor operating at DN values of up to 1,000,000 is shown in Fig. 4. The same type of bearing mounting with grease cavities surrounding both bearings is employed, as shown previously, the uniqueness of this design being the hollow shaft and tie bolt assembly employed. This was done to minimize the transfer of heat from the hot turbine and compressor disks to the bearings. Air is drawn through the center of the bearing shaft for additional cooling.

Figure 5 shows a high speed turbine mounting of a grease lubricated jet engine starter application. The front and rear turbine bearing closures are completely filled with grease. An actual jet engine starter was tested in the laboratory and the final design recommendation resulted in considerably improving the overall life of the bearings in the high



these are the reasons why Dole Thermostats are standard equipment on 37 of the leading makes of cars, trucks, tractors, commercial vehicles, industrial and marine engines.

- Positive operation against increased pump pressures
- Good service with all types of antifreeze solutions
- Help maintain best engine performance
- Speed warm-up and get more heat from the car heater.

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AUTOMOTIVE ENGINEERING NEWS
PROPERTY AND APPLICATION DATA
ON THESE VERSATILE ENGINEERING MATERIALS:
"ZYTEL," "ALATHON," "TEFLON," "LUCITE."

No. 3, 1956

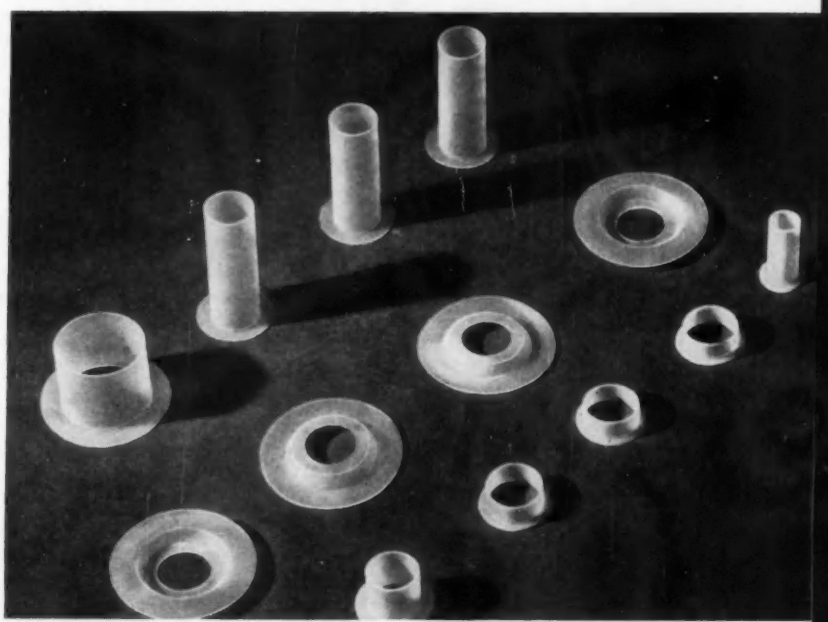
Bearings of ZYTEL® nylon resin resist wear . . . can operate with or without lubrication

Simple sleeve bearings of "Zytel", with lubrication, can support loads up to 1,000 lbs. psi at rubbing velocities up to 500 feet/min.

The physical properties of Du Pont "Zytel" nylon resin are particularly applicable to the field of automotive engineering. The strength, heat resistance, resilience and lightness in weight of "Zytel", coupled with its moldability, have already been put to use in many specific jobs.

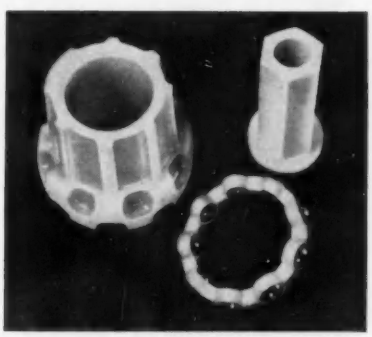
"Zytel" as a bearing material is unique in that it can perform satisfactorily over a useful range of loads and operating conditions, with little or no lubrication. This characteristic is extremely valuable for bearings which must operate in hard-to-reach spots where lubrication is a problem. The resistance of "Zytel" to oils, gasoline and grease further expands its range of usefulness.

Of equal interest are the design possibilities that exist with *lubricated* bearings of "Zytel". Recent Du Pont laboratory tests revealed that simple sleeve bearings of "Zytel", under conditions of hydrodynamic lubrication, can support loads up to 1,000 psi at rubbing velocities up to 500 fpm with negligible wear. These tests also revealed that with "Zytel", hydrodynamic lubrication can be maintained with a minimum amount of lubricant present. In one case, with only an initial lubrication of a bearing, the bearing operated continuously for 41 days without increase in temperature or torque.



These brake-pedal bushings and window crank-handle bearing plates are made of "Zytel". The parts give smooth, quiet operation and provide long-wearing bearing surfaces which, after assembly, do not have to be lubricated for the life of the vehicle.

It may pay you to examine your own automotive-design requirements with "Zytel" in mind. If you have a bearing-design problem, consider these many advantages of "Zytel". It may help you cut costs, simplify production and increase operating efficiency. For the most recent specific information and test data, fill out and mail the coupon below.



Representative bearings and bushings of lightweight "Zytel" nylon resin feature excellent abrasion resistance, toughness in thin sections, heat resistance and resiliency.

NEED MORE INFORMATION?

For complete details that will help you further evaluate Du Pont "Zytel" for use in your product development program, mail the coupon at the right.

E. I. du Pont de Nemours & Co. (Inc.)
Polychemicals Department, Room 43, Du Pont Building, Wilmington 98, Delaware

Please send me more information on Du Pont "Zytel" nylon resin. I am interested in evaluating this material for_____

NAME_____ TITLE_____
COMPANY_____
STREET ADDRESS_____
CITY_____ STATE_____
TYPE OF BUSINESS_____

speed turbine position, which was the prime cause of starter failure. This was the result of research investigations on methods of lubrication, methods of sealing and venting, as well as bearing design and mounting methods.

A split inner ring bearing operating in the neighborhood of 1,000,000 DN is shown in Fig. 6 supporting the thrust load from the compressor section of a small gas turbine engine. Oil jet lubrication is employed. The operating temperature of the bearings in this type of application is not more than approximately 300 F. The turbine end bearing of the output section is also oil jet lubricated.

In this particular application, the compressor section operates at approximately 35,000 rpm and the output section at approximately 25,000 rpm with a reduction to 6000 rpm for the power output shaft.

Specially designed high speed bearings have operated successfully for over 500 hr between overhauls in several of these types of small gas turbine engines.

Executives Read
AUTOMOTIVE INDUSTRIES

Perspective Drawings

(*Continued from page* 29)

limitations, the system drawing is also used for installation purposes and details the attaching parts as well as tube assemblies and connecting fittings. In tubing drawings, prelocating of clips is avoided whereever possible because the slightest variation in fabrication may result in misalignment of the tubing and possible system failure.

Harness installation drawings are released as separate electrical, radio, and radar installations and, as in the case of the tubing drawings, the arrangement of views is designed to fellow the pattern of work areas used inthe shop.

Clamps and other hardware used to secure harnesses are called out in the notes section of these drawings, and harness numbers are referenced frequently to adequately outline the routing.

Since harnesses are tooled to a pre-determined length, clamp locations are completely dimensioned on the drawing to assure the correct amount of free length at points of connection.

Information for wire routing within junction boxes and instrument panels is controlled through the use of connection diagrams and photographs. The photograph numbers are referenced at the point of use and are also listed in the drawing's general notes. These photographs are located in convenient blueprint files at Convair and are filed under the drawing number for which they are effective.

The obvious advantage of providing the installer with a picture of the installation he is to make, coupled with the fact that the drawings can be readily maintained, has been responsible for acceptance of the perspective drawings as bonafide engineering information.

The use of illustrations in solving production problems is not a new approach, but it is believed at Convair that broad application of this old theory within the framework of the regular engineering release system is certainly a new concept in drafting.

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IF YOU WOULD LIKE TO KNOW MORE about a career at CAE, write for this illustrated brochure outlining the company's role in research and engineering, and suggesting YOUR place in this organization.
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DETROIT 15, MICHIGAN
SUBSIDIARY OF CONTINENTAL MOTORS CORPORATION

Bonding Techniques

(*Continued from page* 54)

ished joint. A reliability factor for any given adhesive bond is determined by the number of rejects of production parts, consistency of test results, and the service performance record of parts bonded with the adhesive.

From the processing and reliability data, it was decided that a two adhesive bonding system would be used on the Model 51 parts. A vinyl-phenolic type adhesive film, with a liquid primer, was used to bond the aluminum skins to the honeycomb core. A thermosetting, nitrile-phenolic type adhesive film with a phenolic base primer was selected for bonding metal-to-metal joints. By the use of this two adhesive system, parts containing both metal-to-metal and honeycomb-to-metal skins can be bonded in one operation to produce high quality airframe components.

There were several reasons for selecting the vinyl-phenolic adhesive system on the honeycomb to skin bonding. The adhesive has been widely used and has produced many varied honeycomb sandwich structures that have given satisfactory performance.

(*Turn to page* 86, *please*)

you can meet any lubrication standard if you

BLEND WITH ENJAY PARANOX®

(VISCOSITY-INDEX IMPROVERS)

Base stocks blended with Enjay Paratone can be compounded into lubricants combining cold-weather quick starting properties with high temperature, low consumption characteristics. These lubricants are *all-season* oils, featuring improved gas mileage. More and more refiners and blenders are relying exclusively on Paratone to produce the high "VI" required in these all-season oils.

Through years of intensive research and development work with automotive manufacturers, Enjay has developed the only *complete line* of high quality additives (Paramins®) that can assure *maximum* performance characteristics. Why not let this experience and know-how work for *you*? Write, wire or phone the Enjay Company today.

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Hundreds of manufacturers here and abroad have found the answer to their toughest fastening problems in HUCK'S complete line of commercial, positive-locking rivets.

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U.S. Patent numbers 2531048, 2531049, 2754703, 2527307 and patents applied for.

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International Harvester Adds Two New Trucks to Line

Two more heavy-duty all-wheel-drive models have been added to International Harvester's motor truck line.

These new units — the R-190 (4x4) and RF-190 (6x6) — complete a lineup of all-wheel-drive International trucks that now ranges in gross vehicle weight ratings from 7000 to 43,000 lb.

Model R-190 (4x4) is rated at 29,000 lb GVW, and is available in four wheelbases from 142 to 193 in. Model RF-190 (6x6) is available with choice of bogies to provide GVW ratings of 38,000 or 43,000 lb. Four wheelbase lengths range from 157 to 211 in.

A new front axle design featuring a one-piece center section is combined with outrigger-type front spring mounting for better stability and a minimum increase in front-end height. Low rear-end loading height is accompiished without the need for cutting and dropping the frame in back of the cab.

Frame reinforcements have been extended forward beyond front spring mountings for additional front end strength and rigidity.

The transfer case, including a 13-in. parking brake, is designed to provide proper propeller shaft angles for longer component life and quiet operation. A larger steering gear permits easier manual steering. Front axle capacity is 11,000 lb. With optional power steering, capacity is 14,000 lb. A full-torque power take-off mounted on the transfer case is available on both new models.

A choice of three gasoline and three LPG-powered engines are available in each model. High-altitude pistons are standard in LPG engines.

A total of 12 models is now available in the International line on all-wheel-drive trucks.

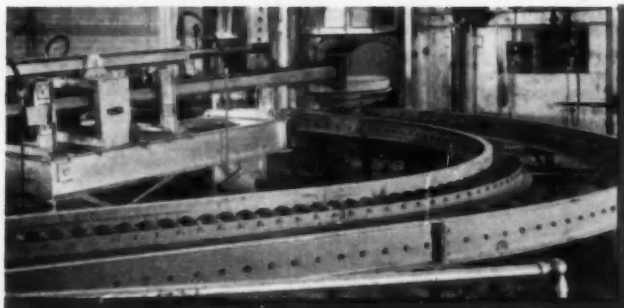
Ryerson Steel Expanding in St. Louis

Joseph T. Ryerson & Son, Inc., warehousing subsidiary of Inland Steel Company, has entered into an agreement with the Jasper Blackburn Corp., St. Louis, to lease the Blackburn property on north First St. which will be used to expand the Ryerson Company operations in St. Louis.

The property has a total area of 67,200 sq ft, of which 31,200 sq ft is improved with a one-story building. A two-span warehouse, 150 ft by 240 ft, will be erected on the vacant portion.

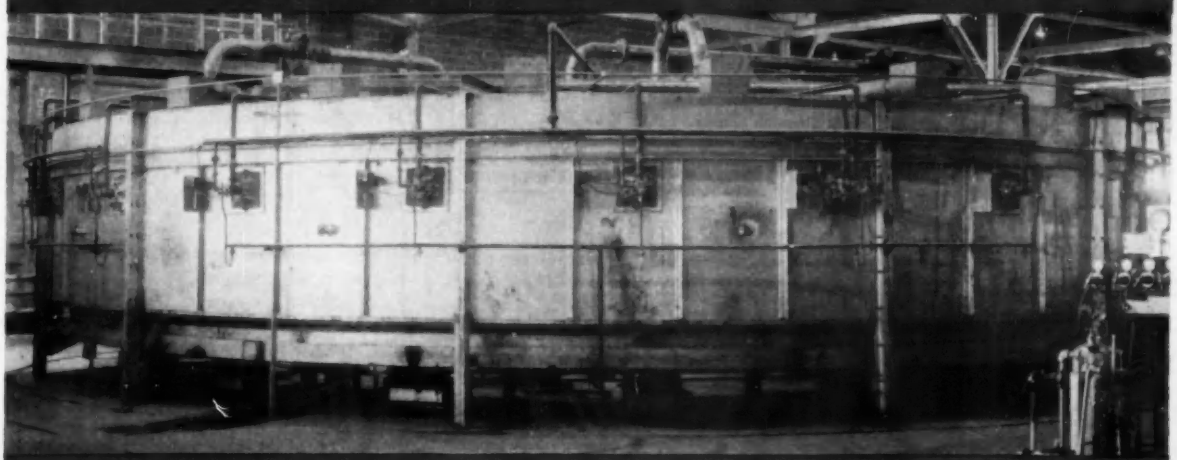
The present Blackburn building will be used for warehousing Reynolds aluminum in coil, sheet, plate, rod and bar form and will mark the Ryerson company's entry into the aluminum field in this territory. The new spans to be constructed will be used for the company's sheet and strip division. A 52-in. slitter line and a 52 in. cut-to-length line will be installed, along with additional sheet shearing capacity.

Engineering work has begun on the new warehouse building, with the entire project scheduled for completion by the end of this year.



This furnace is set up for automatic loading in regular plant production line.

This field-erected Lindberg rotary hearth furnace is one of several completed, under construction and on order, for plants in U. S. and Canada.



Every so often we want to remind you . . .

LINDBERG Builds Big Ones!

Yes, Lindberg does build big ones! The rotary hearth furnace shown here was field-erected by Lindberg Industrial. It is used for heat treating car wheels and is set up for automatic loading. It's outside diameter is 44 feet and capacity is over 13,000 lbs. per hour.

This is just one of many types of industrial heating equipment, heat treating furnaces, melting furnaces, enameling furnaces, ceramic kilns, that Lindberg is prepared to design, construct and install in your own plant.

Lindberg's years of experience in the broad field of industrial heating equipment, its staff of expert laboratory technicians and seasoned application engineers assure your getting the best suited installation for your process and production requirements.

Whatever your needs, if it has anything to do with the application of heat to industry, better talk it over with Lindberg. Just get in touch with your nearest Lindberg Field Office (see your classified telephone directory) or write us direct.

LINDBERG INDUSTRIAL

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Los Angeles Plant: 11937 S. Regentview Avenue, at Downey, California

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Bonding Techniques

(*Continued from page* 82)

This particular nitrile-phenolic adhesive produces good bonded joints when cured under relatively low pressures. Handling, storage and processing were easiy adapted into Temco's bonding department.

In evaluating a number of methods for attachments to the sandwich construction parts, it was found that loads introduced at the attachments were most efficiently introduced into and distributed through the structure by filling the core area around the attaching point with a high strength resin. A number of filler materials were evaluated and a one-part epoxy resin base compound was found that would withstand the stresses imposed on the attachments.

After rugged flight test evaluations by Temco and the services, the adhesive bonded and reinforced plastic structures on the Model 51 are proving to be most reliable.

IDENTITY
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These two precision component parts require equally precision, perfectly legible marking on specially designed Matthews Machines for positive identification and assembly. Regardless of your product, let Matthews provide engineered, custom-built Marking Tools for every production rate.

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Jet Engine Parts

(*Continued from page* 39)

minimize deflection during pouring.

Through the use of these procedures the high standards required in the jet engine support rings were achieved, with the number of rejects extremely low, even in the first production runs. The parts are now being produced for Pratt & Whitney Aircraft on a regular basis.

New Five-Speed Transmission

(*Continued from page* 30)

to the same speed as the sliding clutch and the mainshaft to which it is splined.

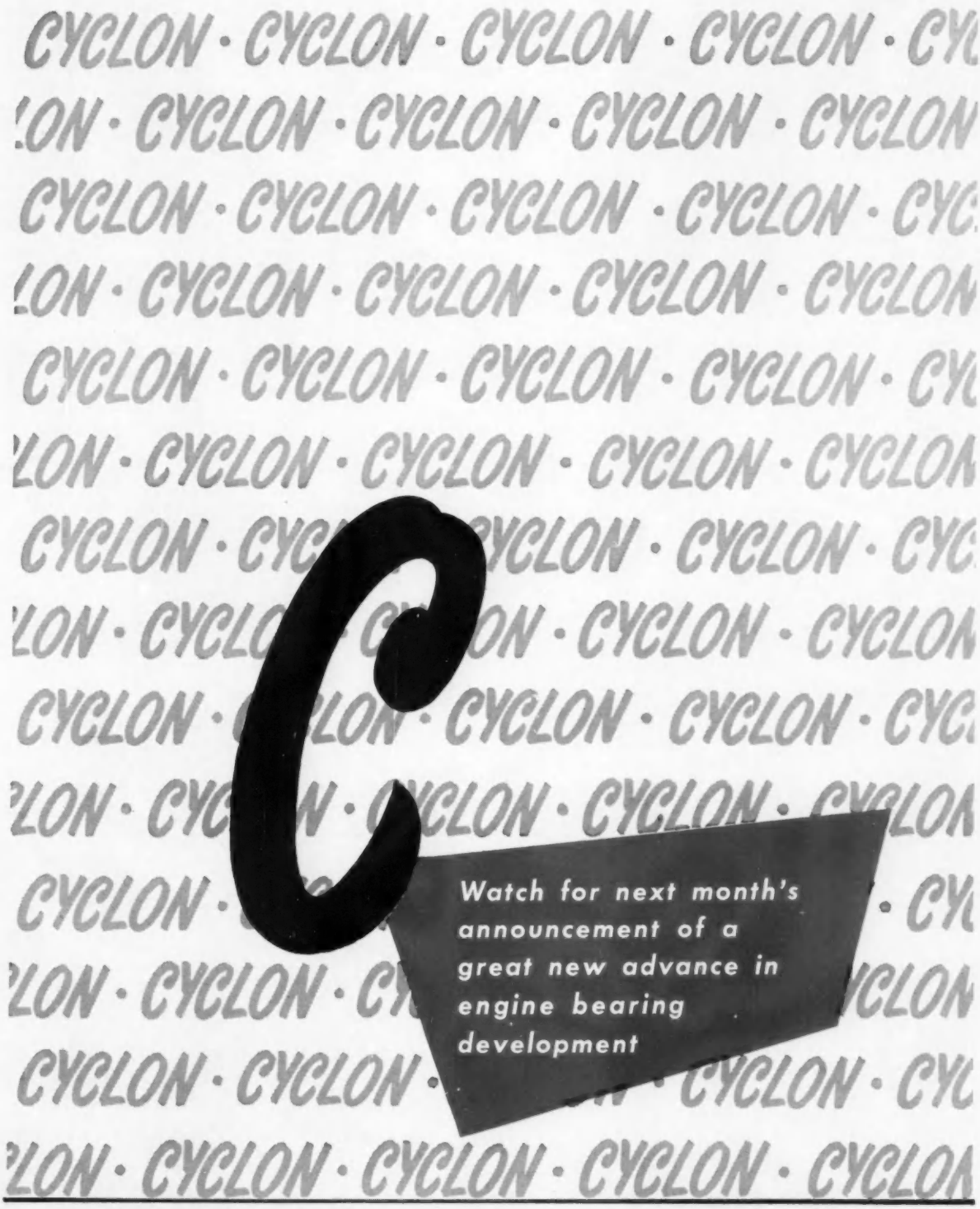
At this point, continuation of the shift effort causes a slight rotation of the outer stop ring and its gear, relative to the sliding clutch. This rotation, about 0.5 deg. allows the clutch to slide over the large diameter of the pins, and engagement of the clutch teeth on the gear without clashing.

An allowance for thermal expansion between the aluminum inner stop ring and the steel outer ring is made by leaving an axial clearance, or "float," in the synchronizer unit at assembly.

BOOKS . . .

ESTABLISHING AN INTEGRATED DATA PROCESSING SYSTEM, *published by American Management Association, 1515 Broadway, New York 36, N. Y. Price, $4.50 (AMA members: $3.50).* Integrated data processing has been defined as the systematic organization of every data processing operation in a company—with or without the installation of a costly electronic system. In basic, non-technical language, this book explains how companies can establish such a system. The IDP network is described in detail—from preliminary approaches to actual installations. Reports of actual company experiences show how IDP can help executives obtain accurate information quickly.

STRUCTURAL CHEMISTRY AND METALLURGY OF COPPER, *by D. K. Crampton, published by American Society for Testing Materials, 1916 Race Street, Philadelphia 3, Pa. Price, $1.50.* In this publication of the Fifth Gillett Memorial Lecture, Dr. Crampton discusses some of the new work on recrystallization and grain growth of copper alloys. His lecture also covers the structural chemistry of copper and copper alloys, particularly in relaxation of grains and grain boundaries, both in pure copper and in some copper alloys.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Watch for next month's announcement of a great new advance in engine bearing development

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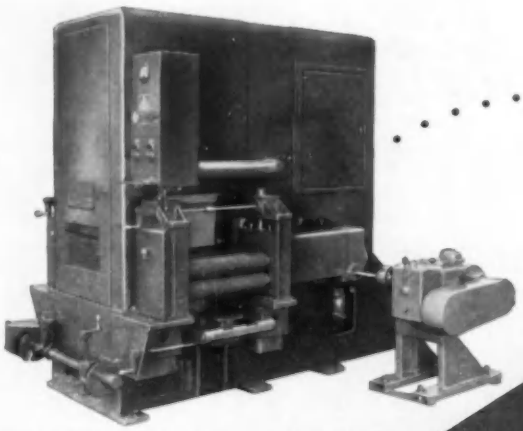
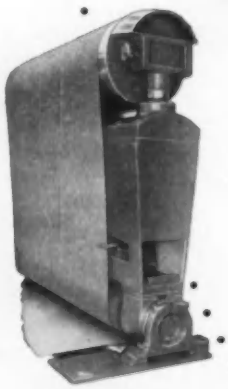
MANUFACTURERS OF ENGINE BEARINGS FOR ORIGINAL EQUIPMENT SINCE 1925



ABRASIVE BELT GRINDING & POLISHING MACHINE
(Pinch Roll Type)

For pre-finishing, conditioning and polishing sheets, plates, strips or blanked-out shapes in flat form. Used as single units or in multiple units for progressive line polishing.

for FINISHES that pass inspection the FIRST TIME get a HILL Grinding & Polishing Machine



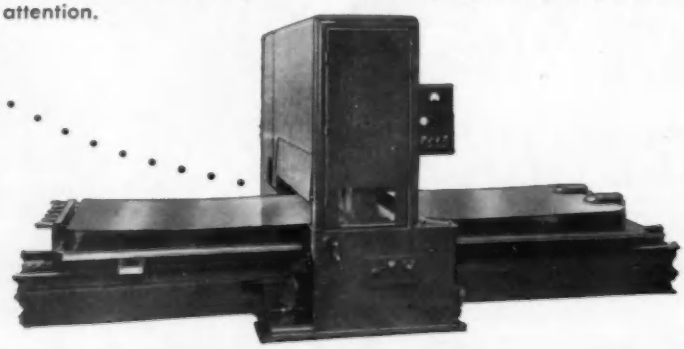
The basic HILL two-roll vertical head with endless abrasive belt. Used in both the Pinch-Roll and the Hydraulic Table types.

● HILL 2-ROLL Vertical Abrasive Belt Grinding and Polishing Machines are made in two general types for producing superior finishes on flat surfaces as required by manufacturers of a wide variety of products such as decorative plastics, auto bumpers, engravers plates, home appliances, etc.

Both types are built in polishing widths up to 60" and larger sizes can be furnished if desired. Your problem will be given our prompt and careful attention.

ABRASIVE BELT POLISHING MACHINE
(Hydraulic Table Type)

For flat polishing of sheets and plates of ferrous and non-ferrous metals. Made in a variety of table widths and lengths with full hydraulic reciprocating table.



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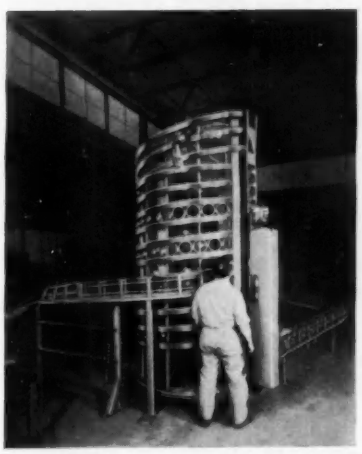
AUTOMATION
News Report

(Continued from page 53)

ROTARY STORAGE UNIT

A HIGH-CAPACITY, pneumatically operated storage unit for workpieces that can roll has been developed by Gear-O-Mation Div., Michigan Tool Co. Designed for use in automated processing lines, the device offers a true demand-feeding system from a controlled storage medium.

The rotary storage unit can be adapted to many applications. Each



Gear-O-Matic storage unit shown here is used to store and feed ring-gear blanks for a broaching operation. Capacity is over 300 units.

unit is custom tailored to a specific job and is assembled from standard components. The rotary form is provided in either circular or oval-like shape to suit particular floor requirements.

In operation, parts are guided through a silhouette accept-reject device to fully caged double threads (or tracks) and are then gravity fed to an elevator, which has two shafts and works off a stroke-lift piston. A closed-circuit hydraulic cylinder coupled to the air cylinder provides variable lifting speeds. Either elevator shaft can be operated independently of the other.

As the parts leave the elevator they are gravity rolled down the circular tracks to the exit chute take-off, where they can be positioned vertically or horizontally for the next machine operation. Gates operated by air cylinders control movement of the parts on demand.

Input of parts to the device automatically stops when desired capacity

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SPRING WASHERS

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GARFIELD 6-4000

The thousands of dies in our stock permit the making of nearly every size Belleville, Bevel, Three-Wave, Four-Wave and many other types of Spring Washers to fit your Engineering requirements without extra tool charges and within just a few days after receipt of your order. Garrett's large stocks of spring steel, stainless steel, phosphor bronze and beryllium copper combined with our own plating, die-making, heat-treating facilities and rigid control permit fast shipment of standard or special washers—regardless of quantity.

Depend on GARRETT for all small parts.

FLAT WASHERS—Made to meet new ASA and SAE standards . . . available in steel, brass, bronze, monel, aluminum, and stainless steel . . . finished to your specifications.

HELICAL SPRING LOCK WASHERS—with controlled tension for tighter assemblies.

METAL STAMPINGS — Made to your specifications on high-speed production presses.

HOSE CLAMPS — Multi-Clamp, Auto-Seal and Spring-Grip Hose Clamps.

SEND FOR LITERATURE

GEO. K. GARRETT CO., D & TIOGA STS., PHILA. 34
Please send, without obligation, literature on the following:

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☐ STAMPINGS
☐ GARRETT STATISTICAL QUALITY CONTROL

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Title_____
Company_____
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City_____ State_____ Key No. AI-2

XX

This is the twentieth of a series of advertisements dealing with basic facts about alloy steels. Though much of the information is elementary, we believe it will be of interest to many in this field, including men of broad experience who may find it useful to review fundamentals from time to time.

Flame-Hardening Alloy Steels

When the surface of steel is subjected to direct application of flame and heated above the transformation range, then hardened by quenching, the process is known as flame-hardening. Its primary purpose is to surface-harden without affecting core properties. Jets of flame are played directly on the steel, and hardness penetration can be made to vary considerably. Usually in alloy steels this depth will range from 0.03 to 0.12 in., the actual figure depending upon the method of heating and quenching used.

Unlike carburizing, flame-hardening does not involve the absorption of extraneous elements by the steel. There is no alteration of the chemical composition. To put it simply, the steel must have its own self-hardening characteristics; cannot be dependent upon carbonaceous salt baths, gases, etc.

Flame-hardening is not a substitute for the conventional furnace method. Each has its uses. The particular virtue of flame-hardening is that the flames can be directed to localized areas. The furnace, on the other hand, is generally more economical and feasible when parts produced in large quantities must be hardened all over.

Any type of hardenable steel, alloy or carbon, can be flame-hardened, and there will usually be no scale or pitting. The alloy content is the governing factor when determining the quench. In some cases a rapid quench is required; in others, it can be as slow as air-cooling. Tempering presents no problems, for flame-hardened steel can be tempered as if hardened to the same point by other methods.

A list of typical flame-hardened parts would include such familiar items as gear and sprocket teeth, and certain types of cams and rollers, shoe treads, etc. This list is by no means exhaustive; it could include many other parts that often require a localized hardening treatment, especially for wear-resistance.

When seeking information about flame-hardening methods, please feel free to consult with our technical staff. Bethlehem metallurgists will gladly cooperate, and you can depend upon their suggestions. You can rely on Bethlehem, too, as a source of alloy steels, for Bethlehem makes the complete range of AISI standard grades, as well as special-analysis steels and all carbon grades.

If you would like reprints of this series of advertisements from No. I through No. XVI, please write to us, addressing your request to Publications Dept., Bethlehem Steel Company, Bethlehem, Pa. The first 16 subjects in the series are now available in a handy 32-page booklet, and we shall be glad to send you a free copy.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

has been reached. This is accomplished by causing the static weight of parts to mechanically move air valves, which open or close the gates.

SHORT COURSE IN AUTOMATIC CONTROL

FOR engineers who want to brush up on their control theory and have only a few days to spare, the University of Michigan, College of Engineering, is offering two intensive summer courses on the subject. The first course, which deals with fundamentals of automatic control, is scheduled for June 17-22; the second, on applications, will run from June 24-26. Students of both courses will have the run of the school's computing, instrumentation, and servo laboratories. Closing date for registration is April 15. For more details write to Professor L. L. Rauch, Room 1521, East Engineering Building, University of Michigan, Ann Arbor, Mich.

MOVING PICK-OFF HEAD

ENGINEERS at Northrop Aircraft, Inc., have successfully applied a moving pick-off head to a new, medium-speed, digital computer. The device (see illustration) makes it possible to record on or read 64 magnetic memory drum channels using only two pick-off heads. Both heads are mounted on a transverse carriage, which is geared to make one full cycle up and down the face of the memory drum in about two seconds. Each head records or reads along a spiral curve as it moves up or down. The drum has a storage capacity of 2000 words and revolves at the rate of 2000 rpm.

Moving pick-off head shown here was developed by a team of Northrop scientists and engineers. This is believed to be the first time this device has been used in a computer.

With this mechanism, pick-off circuitry can be reduced to about three per cent of the total required when separate heads are used for each of the 64 channels.

News of the MACHINERY INDUSTRIES

(*Continued from page* 58)

whose properties represent the carbon and deoxidation variations experienced with at least 75 per cent of all mild steel fabricated in this country. These test steels conformed to the most common ASTM classifications, such as A7, A201, A212, A283, and A285.

All of the plate used had normal mill scale or rust, and the joint edges were prepared by oxygen cutting. There was no preweld preparation of the joint, such as grinding or wire brushing.

All of the welds met the radiographic requirements of paragraph UW51 of Section VIII, ASME boiler and pressure vessel code. Fillet, butt, and plug welds, as well as steel casting repair showed consistently excellent radiographic quality.

Another step in the examination of quality with Unionare welding was the preparation of multi-layer welds in accordance with ASTM-AWS Specification A-233-48T to determine mechanical properties. Standard side, root, and face bend tests indicated that the welds have completely satisfactory soundness and bending properties. Typical mechanical properties include:

Yield Strength (0.5 per cent offset)	66,000 psi
Ultimate Tensile Strength	78,000 psi
Elongation (per cent in 2-in.)	28 per cent
Reduction of Area	65 per cent
Charpy Vee Notch (15 ft-lb transition temperature)	—40 deg F
Weld Hardness	75-85 Rockwell B

Typical mechanical properties on A-212 steel are 75,000 to 85,000 psi tensile strength, 65,000 to 70,000 psi yield strength; elongation in two-inches is 25 per cent to 35 per cent, reduction in area is 60 per cent to 70 per cent, and an impact of 15 ft-lb at minus 40-deg F.

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METALS

(*Continued from page 74*)

Continued Stockpiling Supports Zinc

January zinc statistics afforded little to cheer about. Slab production continued at a high figure but domestic shipments fell about 13,500 tons below December. The Government bought about 3000 tons less for the stockpile, and without its support the situation would have been worse.

No doubt the decline in domestic shipments reflected a slightly lower demand from the galvanizers and a continued low activity at the brass mills. Hopes are expressed that spring will bring increased business when the automobile tempo rises. There is no uneasiness over maintenance of the present 13½-cent price as long as stockpile purchases continue, even on a reduced scale. But no one is certain how long such buying will continue.

Much the same applies to lead, although there is less apprehension of dire results if stockpiling stops. While lead production increased about 66,000 tons last year, shipments held up quite well. February business was down, but this is seasonal. Buyers are reluctant to increase inventories and the sad action of the copper market has had a restraining influence, although there is little parallel in the markets for the two metals.

Aluminum Extruders In Trouble

The aluminum extrusion industry, which until recently was enjoying a real boom, has encountered stormy weather. It's the old case of too many entering the business. Prices have dropped 10-20 per cent. The price war is not confined to the independent extruders, but has brought in the four major producers as well.

Basically, the trouble is probably the over-supply of aluminum, which is now freely acknowledged. The problem today is to match supply and demand. While consumption this year is expected to be up 10 per cent over 1956 to 2,300,000 tons, the supply, including secondary and imports should total 2,500,000 tons. There is some chance that production will be less than forecast because of power shortages in the Northwest and in Canada, but the cut will not be severe. As no reduction is expected in the price of aluminum billets below present market of about 29 cents a pound, the extruders are pinched with some obliged to sell below cost to stay in the business.

From a longer range standpoint the industry appears to have nothing to fear. By 1960, it is declared, demand will once more have overtaken present and planned production. Particularly hopeful is the prospect of increased use of aluminum in automobiles and in housing.

Low Nickel Steels

Nickel shortage continues acute, but some relief may be obtained through elimination of stockpile requirements in 1957 by the Office of Defense Mobilization. This metal, which came to nearly 80 million pounds last year, will be available for industry.

It also appears that introduction of the new 200 grade of stainless will lessen the need for nickel in that product and permit its more essential allocation for high temperaure alloys. Types 201 and 202 stainless are comparable in many ways to 301 and 302 grades but are not flatly substitutes. In their manufacture, manganese is used to replace about half the nickel.

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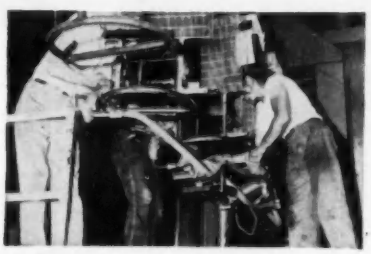
JOIN WITH HANDY & HARMAN SILVER BRAZING FOR PERMANENT PROFIT

After brazing, the assembly undergoes the first of four leak tests in a water-filled tank. It is then given a carefully controlled dehydration and vacuum test.



To further insure that the vacuum is maintained, the assemblies enter a helium atmosphere; the smallest leak would draw helium into the system.

Next they are tested by the spectrometer which is calibrated to detect a concentration of helium equivalent to a leak rate of one ounce of refrigerant in 200 years.

How to Join Refrigerator Tubing So It Won't Leak

Hotpoint Company's new refrigerator assembly plant in Chicago boasts one of the most advanced mass-production assembly line operations in the industry. It boasts, also, one of the most stringent quality controls in the industry—with 83 quality checks and tests during manufacturing. Four of these tests are positive checks for hermetic sealing, the most exacting being the mass spectrometer test which can detect a potential leak of one ounce of refrigerant in 200 years.

To a great degree, hermetic sealing depends on the quality of the joints in the tubing connecting the major components of the system . . . Hotpoint's are silver brazed with Handy & Harman's EASY-FLO 45 and HANDY FLUX. Some of these joints are copper-to-copper, others copper-to-steel and the rest steel-to-steel; all are EASY-FLO brazed and have a tensile strength of 30,000 psi.

These gruelling production checks are met, basically, with a 3/64″ silver alloy wire, double-tipped hand torches fueled by a mixture of natural gas and oxygen, and HANDY FLUX. These are the ingredients of EASY-FLO brazing used by Hotpoint in assembling their refrigeration units. Simple, isn't it? And all the more remarkable in view of the tests the brazed joints must pass.

A joining method this simple, this fast, this economical and this strong warrants your consideration for your product. Ask us for all the facts.

SEND FOR BULLETIN 20

BULLETIN 20 tells you why high strength, speed and economy are inherent in EASY-FLO brazing. Also gives Handy information about joint design and fast brazing methods. We'll be pleased to send you a copy.

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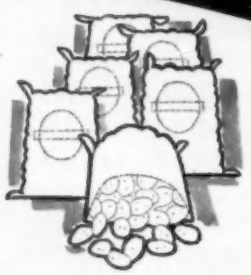
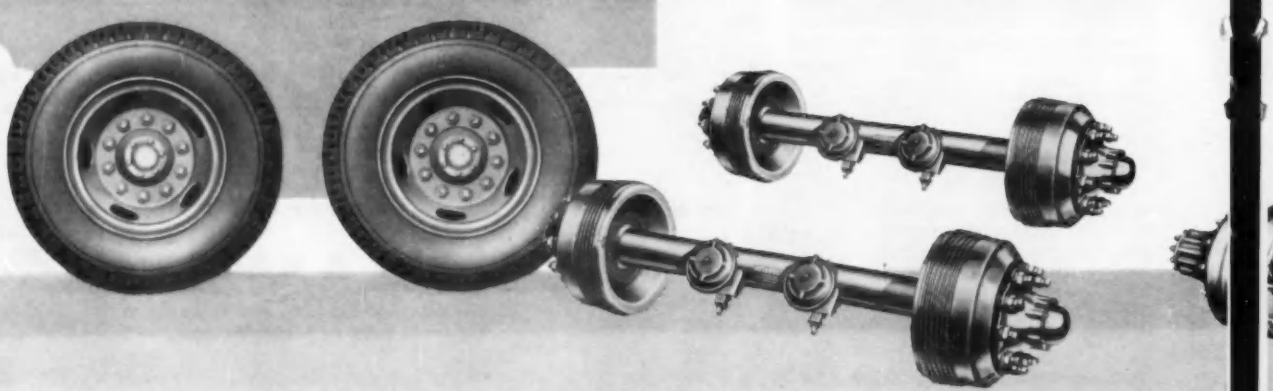


Up to 9 *more* 100-lb. sacks of potatoes per load!



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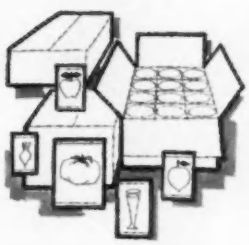
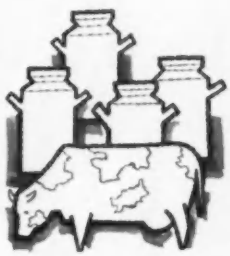
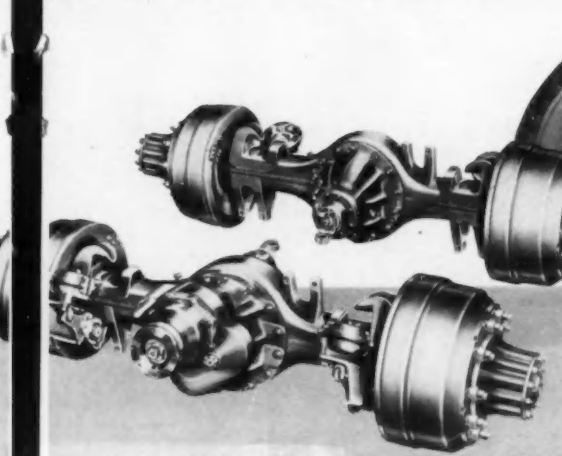


Up to 21 *more* cases of can goods per load!



Up to 110 *more* gallons of milk per load!



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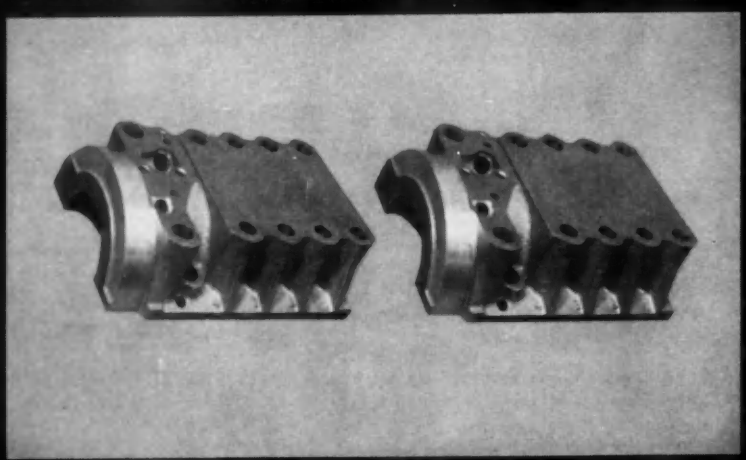
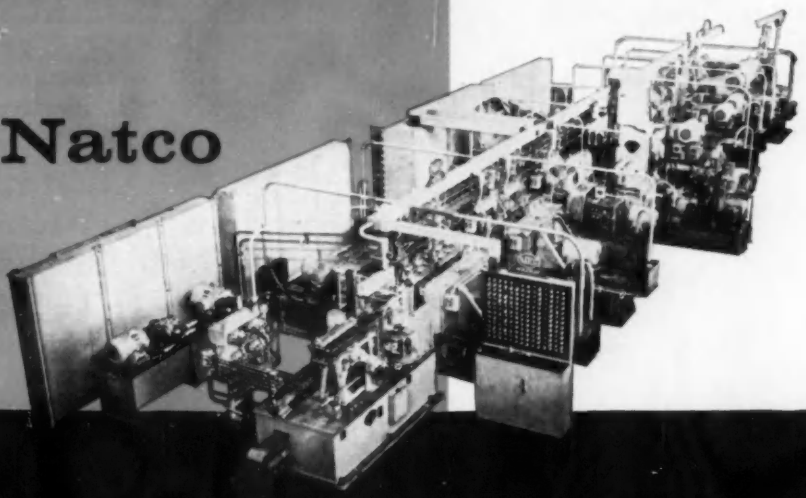
2-at-a-time processing



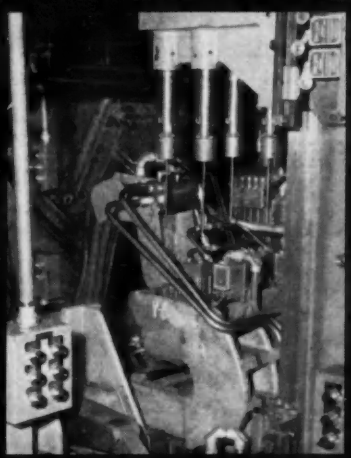
300 HP Natco greatly increases production by processing two complete sets of bearing caps at once.

Bearing caps—240 *sets* per hour—six times the production rate of the machine replaced! This new Natco processes two complete sets at once. It loads surface-broached castings automatically, performs 80 machining operations, places matched sets of finished bearing caps on the assembly conveyor. In addition to broaching and sawing, this 300 HP, 27-station Natco, drills, reams taps, turns, mills, probes and faces.

help this Natco 600%

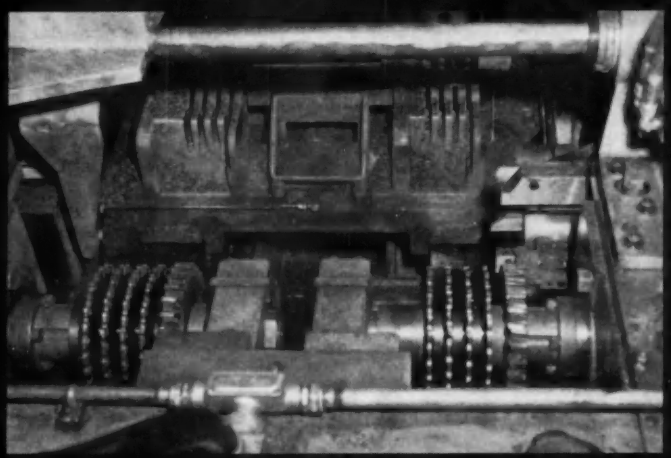


Unique Broaching Station



Fully automatic broaching station eliminates need for withdrawing broaching tools after cut. Broaching tools are pulled completely through hole, removing .030" stock.

New Rigid Saw Station



80 HP sawing station cuts two castings into complete sets of 5 caps each. All surfaces parallel within .0015". Fixture feeds castings into stationary mounted saws, providing rigidity for accurate 14 ipm cutting.

Whatever your high production problem, our engineers will work closely with your people to develop exactly the method and the machine to do your job best. Besides special way-type, index and transfer machines, Natco also builds multiple drilling, boring, facing and tapping machines. Call your nearest Natco office in Chicago, Detroit, Buffalo, New York, Boston, Philadelphia, Cleveland and Los Angeles. Distributors in other cities.

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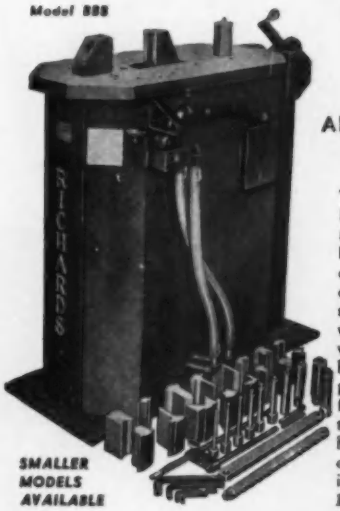

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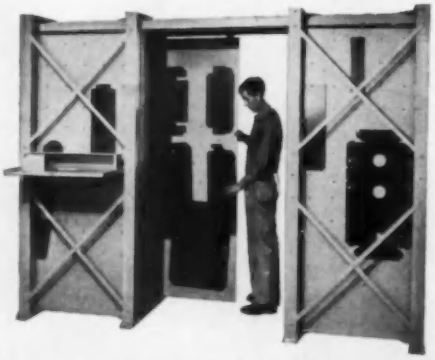

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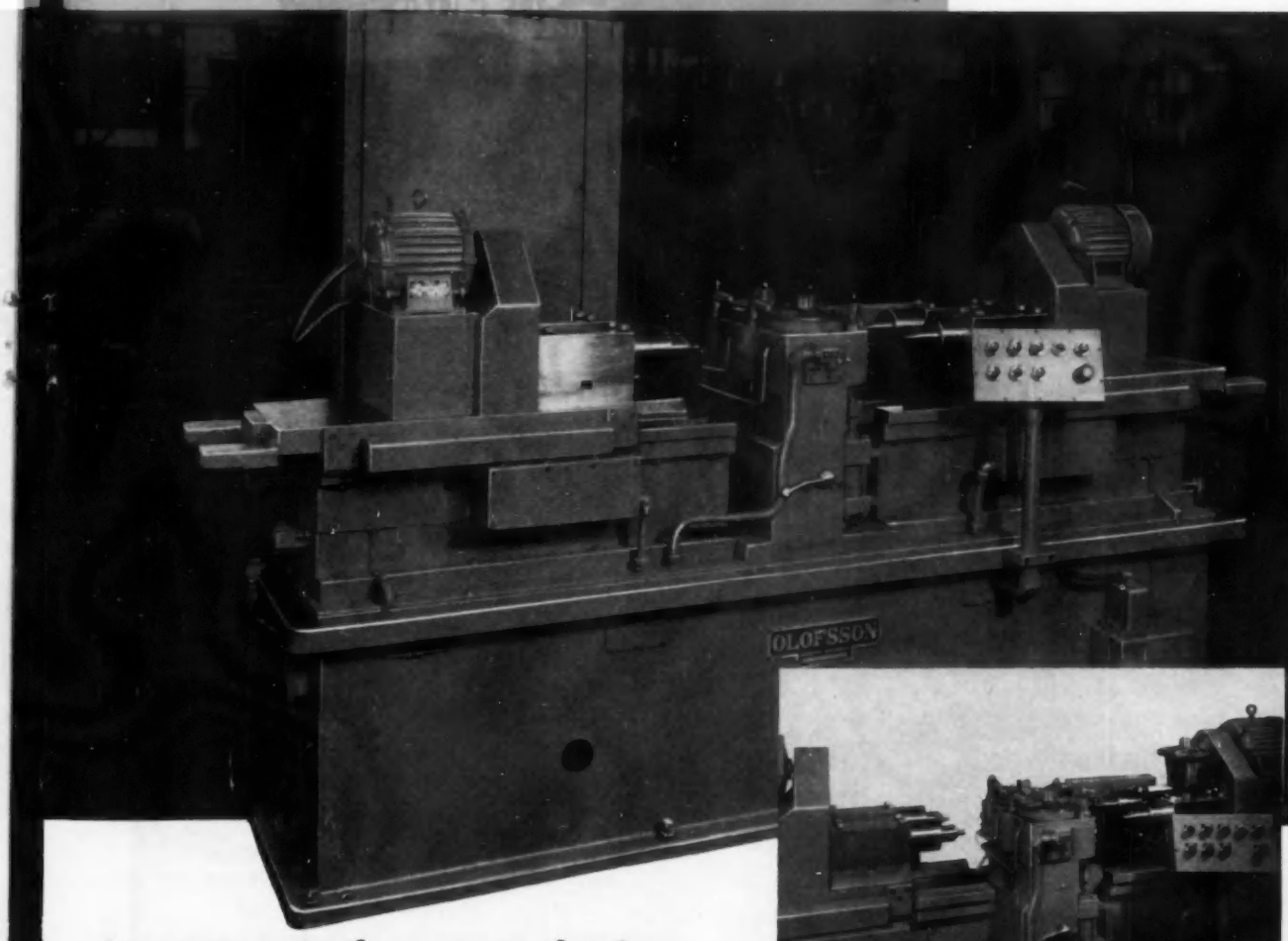

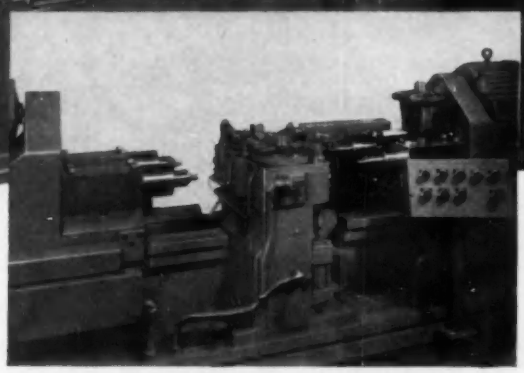

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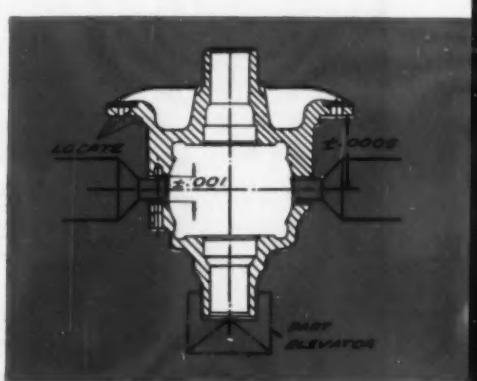

Diagram of differential case clamped into position for simultaneous, double-end precision boring operation.

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to specs. 7/16" - 4-1/4" cross flats

special machines + large stock of material × years of experience = speedy deliveries high quality low prices

Here are a few samples made to customers specifications . . Our batteries of special high-speed multi-spindle, automatic machines make possible fast and accurate production of hexagon nuts of non-standard height and special shape from carbon or alloy steel, Naval bronze or other non-ferrous metals; also AN 310 through AN 335 as per latest Airforce specifications. Very often the special nut you require may be similar to one we are already making and a simple modification would result in a price advantage and quicker deliveries to you . . Send us your blueprint and particulars —let us quote on your requirements . . We also have a catalog that contains complete specifications, engineering data and prices regarding our standard nuts.

*Also 12 Pointer brochure on request.

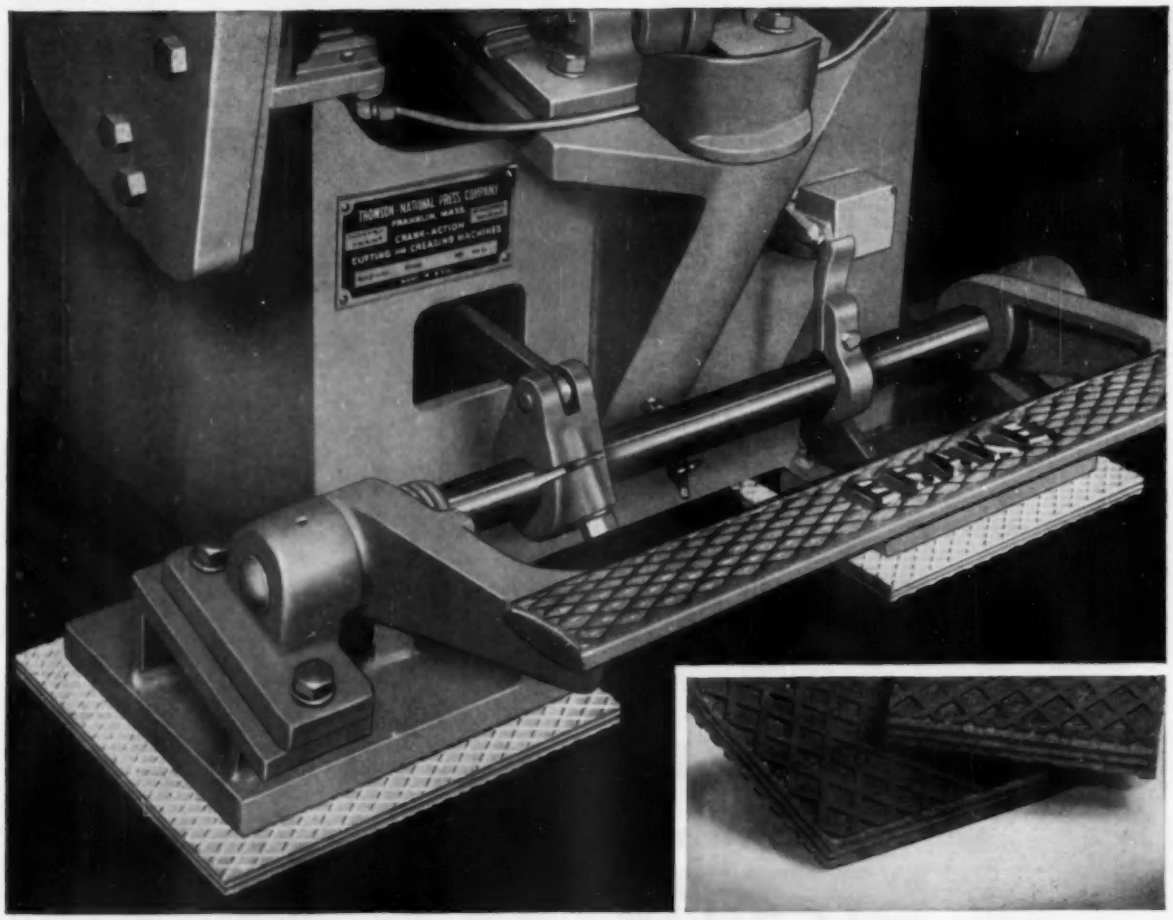
NATIONAL MACHINE PRODUCTS COMPANY

*Manufacturers of Standard and Special *12 Pointer and Hexagon Nuts . . . "Huglock" and "Marsden" locknuts.*

44233 Utica Rd., UTICA, Michigan

Another new development using

B.F.Goodrich Chemical *raw materials*



"Air-Loc" Machine pads are made by Clark-Cutler-McDermott Company, Franklin, Mass.

Machine pads made with Geon "snap back" after repeated 1000 psi loads

THIS new machine mounting pad to reduce machinery noise and vibration is quickly installed without bolting or cementing.

The pads are made of Geon polyvinyl resin, sisal, and granulated cork, fused into an integrated pad. Geon resin binds the materials, makes the pad resistant to water, oil, grease, most acids and alkalis. The pad is strong, yet flexible. Even after repeated loadings to 1000 pounds per square inch, the pad recovers 99% of original thickness.

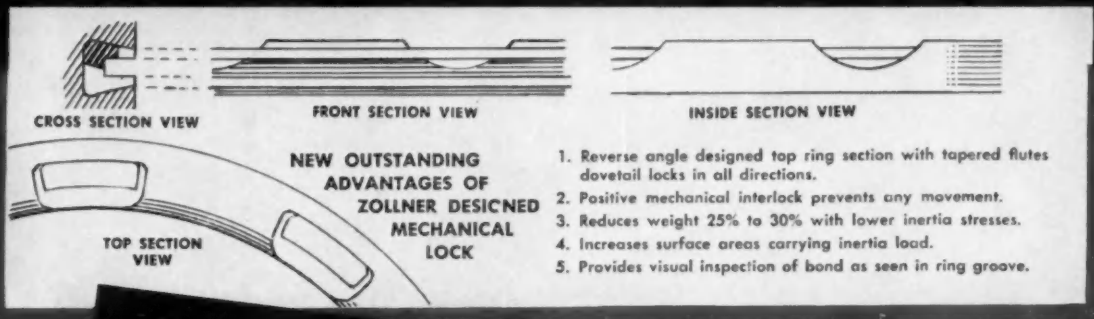
Geon polyvinyl resins, compounds, latices, and polyblends are highly versatile materials that can make *your* products better too. Use Geon for extrusion-molding—or a superior coating. For information write Dept. DA-2, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

B.F.Goodrich Chemical Company
a division of The B.F.Goodrich Company

B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

BOND-O-LOC* PISTONS

WITH "NI-RESIST" IRON TOP RING SECTION


CROSS SECTION VIEW
FRONT SECTION VIEW
INSIDE SECTION VIEW
TOP SECTION VIEW
NEW OUTSTANDING ADVANTAGES OF ZOLLNER DESIGNED MECHANICAL LOCK

1. Reverse angle designed top ring section with tapered flutes dovetail locks in all directions.
2. Positive mechanical interlock prevents any movement.
3. Reduces weight 25% to 30% with lower inertia stresses.
4. Increases surface areas carrying inertia load.
5. Provides visual inspection of bond as seen in ring groove.

Double Bonded

METALLURGICALLY Al-Fin Bond

MECHANICALLY Zollner Lock

STOPS!

RING GROOVE WEAR IN HEAVY DUTY SERVICE

"Sensational mileage" is the unanimous report of heavy duty engine builders and transport operators using Zollner "Bond-O-Loc" Pistons. Another great development by Zollner engineers, this super-mileage piston has a "Ni-resist" top ring groove section *permanently* incorporated with the *double* bond of *both* Al-Fin metallurgic *and* the exclusive Zollner mechanical lock. Separation failure is impossible. Ring groove wear problems are eliminated, blow-by prevented, oil consumption minimized, mileage to overhauls greatly increased. We suggest an immediate test of these sensational advantages for your engine.

Licensed under Patents 2,396,730; 2,455,457; 2,550,879

*T. M. Reg. Pat. App. For

ADVANCED ENGINEERING

PRECISION PRODUCTION

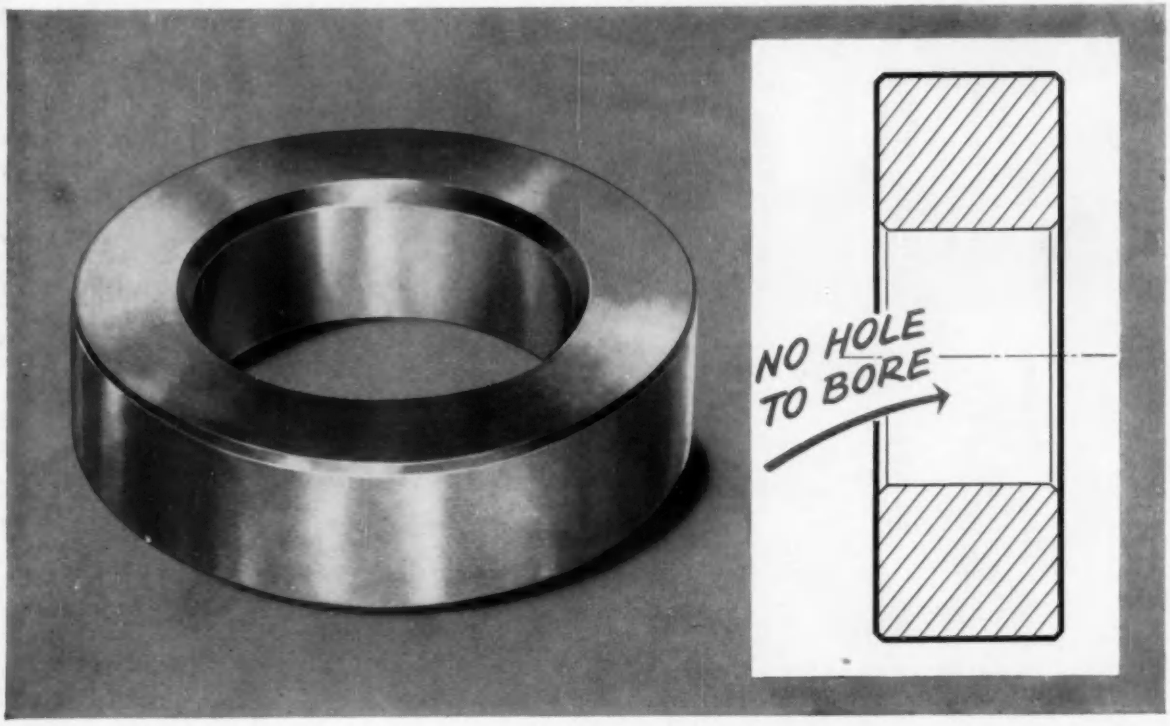
COOPERATION with Engine Builders

ZOLLNER PISTONS

THE ORIGINAL EQUIPMENT PISTONS

ZOLLNER

ZOLLNER • Fort Wayne, Indiana



Steps up gear blank production 300% by switching from bar stock to TIMKEN® steel tubing

AN engine manufacturer felt that his gear blanks were costing him too much to make. The center hole had to be bored out of solid bar stock. It took a whole hour to turn out 29 blanks. And a lot of steel was wasted in the process.

So the manufacturer discussed his problem with metallurgists of the Timken Company, experts in fine alloy steel. After study they recommended a change in production methods together with a switch to Timken® seamless steel tubing in place of bar stock.

With Timken seamless steel tubing, the center hole is already there. It doesn't have to be bored out. Finish boring was the engine maker's first production step. And with Timken steel tubing his gear blanks are now being turned out at 120 to 130 an hour—an increase of 300%.

Machining costs have been cut by more than half. And because the center hole is "built-in", no steel is wasted.

The files of the Timken Company contain records of hundreds of problems that have been solved by Timken fine alloy steel. If you have a tough steel problem, why not bring it to us? Wire, write or phone The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

TIMKEN *Fine Alloy* **STEEL**

TRADE-MARK REG. U. S. PAT. OFF.

SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS STEEL TUBING